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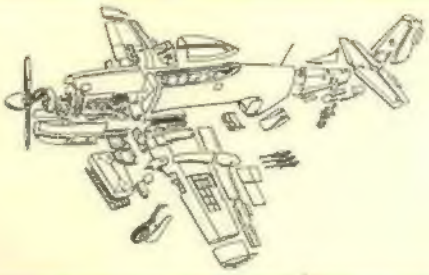

BOEING NORTH AMERICAN VOLUME 19

B-1 LANCER

- Advanced Manned Strategic Aircraft
- B-1A Prototypes
- Production B-1B Serial Numbers
- Systems Details
- Time-to-Climb Records
- Conventional Bombers

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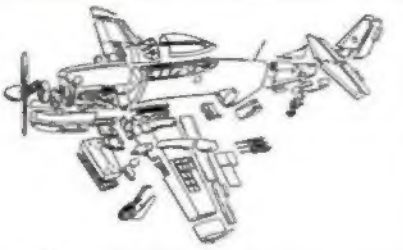

VOLUME 19

BOEING NORTH AMERICAN B-1 LANCER

By Steve Pace

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PREFACE

A WORD FROM THE AUTHOR

The United States Air Force celebrated its 50th anniversary on 18 September 1997. Since 1947 the Strategic Air Command (SAC) has fielded six different types of turbojet-powered bombardment aircraft. This began in July 1950 with a handful of four-engine North American RB-45C Tornado reconnaissance bombers. In 1951 SAC started accepting the six-engine Boeing B-47 Stratojet, and by 1955 operations with the eight-engine Boeing B-52 Stratofortress had begun. The supersonic four-engine General Dynamics/Convair B-58 Hustler entered service in 1960. Nine years later SAC started to receive a small number of two-engine General Dynamics FB-111As.

On 5 June 1970 Rockwell International was awarded a contract to build five B-1A prototypes as the precursor to a potential 240 production models. The Air Force was looking forward to placing the supersonic B-1A in service as a successor to the workhorse B-52.

By January 1971, however, the B-1A contract had already been modified—instead of five flyable B-1A prototypes, there would only be three. There was still a lot of enthu-

Automatically dumping a certain amount of JP-4 fuel to equalize its center of gravity (c.g.), while at the same time demonstrating its fighter-like agility, a B-1B streaks toward the stratosphere during Air Force Phase IV performance and stability tests at Edwards AFB in mid-1985. (Boeing North American)

siasm within the B-1A program, but this marked the beginning of the end for the B-1A as a production bomber.

During 1975 the Air Force was still in search of a new bomber since only small numbers of B-52G/Hs and FB-111As remained in service. Most of the previous types of bombers had already been retired—B-45 in 1953, B-47 in 1967, B-58 in 1970, and B-52C/D/E/F by the end of 1975.

Earlier, during 1955-1965, the Air Force had attempted to acquire several advanced bomber aircraft. It began with the North American B-70 Valkyrie, a proposed chemical-powered bomber (CPB) developed under Weapon System 110A (WS-110A), and a nuclear-powered bomber (NPB) developed by Convair under WS-125A. By mid-1977, the Air Force had lost its bid to procure both the B-70 and the never designated NPB. It had also been denied funds to obtain a fleet of B-1As under WS-139A. But the Air Force remained steadfast.

Then, in early 1981, Ronald Reagan replaced Jimmy Carter in the White House and the largest peace-time military build-up in history began. Only the B-52G/H and FB-111A remained in operational service with SAC. But suddenly, what had been countless years of drought had became a banquet, and the Air Force found itself getting not one but two new bombers. They were the B-1B, a modernized version of the canceled B-1A, and a completely new type of aircraft, the Northrop B-2A stealth bomber.

By the early 1990s, knowing it had a fleet of operational B-1Bs and soon-to-be operational B-2As, the Air Force was finally able to retire the aging B-52G and FB-111A. Thus, at this writing, it is only the old workhorse B-52H that still complements the current fleets of B-1Bs and B-2As.

The Northrop B-2A Spirit was designed from the outset, at great expense, to be a dedicated "stealth bomber." But the B-1B was the result of a significant re-engineering effort to improve its survivability, which most recently revolves around stealth technologies. Although the B-1B is not considered a stealth aircraft, careful tweaking has resulted in an aircraft that is about 100 times less visible to radar than its B-52H counterpart. And it is markedly less noticeable than its B-1A predecessor which had a radar cross-section (RCS) of 2.81 square meters.

There have been numerous magazine articles and books published on the B-1. One of these articles entitled "Bomber One," was written by James L. H. Peck and appeared in the March 1986 issue of *Airpower Magazine* published by Sentry Books in Granada Hills, California. A 1995 book entitled *Rockwell B-1B: SAC'S LAST BOMBER*, was authored by Don Logan and was published by Schiffer Publishing Ltd., in Atglen, Pennsylvania.

More importantly, without the unselfish contributions of a number of dynamic personalities, this reference could not have been completed. These include: Walt Spivak, Boeing North American, Inc. (Ret.); Chris Wamsley, Mike Mathews and Erik Simonsen, Boeing North American, Inc; Mike Machat, Machat Illustration; Tony Landis; and Fred Johnsen, Air Force Flight Test Center History Office, Edwards AFB, California.

After all of the years during which the B-1A-cum-B-1B were in development and production, it is hard to believe that the B-1B has been operational for 13 years as of 1 October 1998. While it is true that several of these fine aircraft, and far too many excellent crew members have been lost in tragic mishaps, the Air Force's B-1B remains the current backbone of the Air Combat Command (ACC). And with its multi-mission capabilities, the B-1B has earned the title, "Jack of all Raids."

Steve Pace
1998

Dedicated to the Memory of Lt.Gen. David J. McCloud, 1945-1998

When the first B-1B (82-0001) rolled out on 4 September1984, it carried a large red number one and the Strategic Air Command crest on the right side of the fuselage.
(Boeing North American)

FOREWORD

BY MR. WALTER A. SPIVAK

Things certainly do happen in mysterious ways—especially within the ever changing aerospace community.

When President Jimmy Carter killed the B-1A production program in mid-1977, thousands of Rockwell International employees received their dreaded pink slips. With their jobs gone, they quickly scattered into the winds of uncertainty. Then President Ronald Reagan resuscitated the B-1 program in late 1981, after some 52 months of uncertainty. Many of those very same workers were rehired to work on the new B-1B production program.

During the uncertain B-1A production program, the original US Air Force Strategic Air Command need for 240 production aircraft had steadily declined to zero. And more than 12 years of engineering and development, including the manufacture and testing of three B-1A prototypes, had been lost. Or so it seemed.

When President Carter axed the B-1A production program, he had the prudence, even though he was under a certain amount of political pressure, to continue B-1A research, development, and flight test activities on a less vigorous level. His action allowed a fourth B-1A to be built as a pre-production prototype, complete with the full array of defensive and offensive systems that had been slated for production B-1As. It joined its earlier three-ship B-1A fleet less than two years later, after making its first flight in February 1979.

Soon afterward, just before President Carter lost his bid for a second term, rumors of an "invisible" or "stealth" bomber program were rife. Unbelievably, they were flowing from the Carter White House. What had been a national secret for a number of years, had been leaked to the American public. Worse, it was leaked to the whole, wide world. Worse yet, the leak was in part to help Carter's re-election campaign. There were a lot of registered voters in California, the most likely construction site for such a bomber and the leak was meant to help justify Carter's unpopular decision to cancel the B-1A. Many Californian aerospace workers had lost their jobs on the B-1A production program and they were extremely unhappy and showed their wrath at the polls.

Much earlier, in May 1964, North American Aviation had rolled out its first new bomber since the XB-45 Tornado back in early 1947. What a fantastic difference! As a dedicated strategic bomber, the XB-70A Valkyrie was to be the fastest and highest flying bombardment aircraft ever devised. In my eyes as chief engineer, in its gleaming white livery, it was also one of the most beautiful aircraft I'd ever seen.

But unfortunately, by the time it debuted, it was no longer a viable weapon system and President John Kennedy had already canceled the B-70 production program. So when the first of two XB-70As appeared, their mission had been reduced to research for America's then upcoming Supersonic Transport (SST) program. This was an important role, but not close to their true purpose for creation. For you see, as originally planned, the B-70 was to initially supplement, and then ultimately replace, the venerable Boeing B-52 Stratofortress. As a dedicated weapon system, operational B-70s would have flown at speeds exceeding 2,000 miles per hour (Mach 3) at altitudes above 90,000 feet. And they were to fly up to 7,600 nm while carrying a 50,000-pound payload of nuclear or conventional weapons.

The loss the B-70 production program in 1961 was followed in 1963 by the demise of its derivative all-missile-armed reconnaissance strike bomber, or RSB-70. The RSB-70 was able to carry and launch up to 20 nuclear strike missiles—ten in either weapons bay. But even as these programs were being terminated, the Air Force continued its effort to find an adequate B-52 replacement. This led to a number of feasibility study contracts for a rapidly evolving series of bombardment aircraft which, by mid-1964, had culminated in the Advanced Manned Strategic Aircraft (AMSA) concept.

As the Air Force bomber requirements landed on our desks, we strived to meet the demands of each and every one of them. But most of these bomber ideas didn't even qualify as good, let alone great. Each new bomber concept

Hundreds of Rockwell employees and invited guests surround the first of four B-1A prototypes during its official roll-out ceremony nearly 24 years ago, on 26 October 1974. Just shy of ten years later, the first of 100 B-1B aircraft appeared publicly for the first time on 4 September1984. (Boeing North American)

created great amounts of grief for our engineers. Their respective range, altitude, payload, and speed requirements fluttered badly in the winds of vacillation. We persevered, however, and in the end we came up with an exemplary plan for the proposed AMSA.

We were one of three finalists in a very hard fought competition on the AMSA program, along with the Boeing Airplane Company in Seattle, Washington, and the General Dynamics Corporation in Fort Worth, Texas. General Dynamics was eliminated early on.

In mid-1970, we won a contract to build five prototypes designated B-1A, to be followed by 240 production aircraft if all went well. For the second time in 14 years we had successfully wrestled with Boeing, the undeniable leader in the large bomber airplane field at the time (Boeing was the other finalist on the B-70 program). And we won the match, or so we thought. While it was true that Boeing wasn't going to build the B-1A, neither were we. Oh, we finally did build three of the five B-1A prototypes originally ordered, in addition to a single pre-production B-1A prototype. But we would never build the other 240 B-1A aircraft that had once been scheduled for production.

So when President Carter canceled the B-1A production program in mid-1977, we of course knew exactly why he had taken such drastic action. Simply put, it was that new technology called

"stealth" which allowed an aircraft, whether it be an attack, bomber, or fighter, to be nearly invisible to radar. But in 1977, this advanced technology was as secret as the Manhattan Project of World War II had been, if not more so. It was a matter of national security—in the first degree!

As a major defense contractor, we of course were aware of this new technology. By late 1977, Lockheed was already secretly flying a stealthy fighter/attack demonstrator called Have Blue somewhere in Nevada, which led to Lockheed's creation of the F-117A Nighthawk. We also had been given a feasibility study contract for a stealth bomber called the Advanced Technology Bomber (ATB). We teamed up with Lockheed while Boeing joined forces with Northrop. Eventually the Northrop/Boeing team won the ATB competition, which led to the creation of the B-2A Spirit stealth bomber in late 1988. As it turned out, however, the loss of the B-2 production program wasn't all bad for us.

When President Reagan took office in 1981, certain cutting edge military planners with strict need-to-know clearances, filled him in on America's top secret stealth programs. He was advised that the stealth fighter and the stealth bomber wouldn't be fully operational until the early to mid-1980s and the mid-1990s, respectively. They added, as part of the Strategic Modernization Program, that at least some B-1s should be built as an interim measure due to the B-52's increasing age and because of the unavailability of stealth-type aircraft for a number of years. Therefore, in October 1981, after looking at numerous options to include such things as Boeing 747 jetliners or Lockheed C-5 transports carrying a bevy of air-launched cruise missiles (ALCM), President Reagan announced that our company would build 100 Long Range Combat Aircraft (LRCA), to be known as the B-1B. When President Reagan said, "Go!," we were more than ready to proceed.

We built the fleet of 100 B-1Bs with the first combat ready one being delivered to the Strategic Air Command in July 1984, and the last one in May 1988. We who had a part in their engineering and manufacturing processes remain extremely proud that their deliveries were completed four months ahead of time, and that the total cost of the B-1B production program came in under the projected budget of $20.5 billion.

Operational for 13 years now, in my biased eyes, the B-1B Lancer is the finest bomber aircraft in the world.

Walter A. Spivak
1998

North American Aviation, Vice President of Research and Engineering on the B-1A Program; Senior Consultant on the B-1B program

Walter A. "Walt" Spivak was born in Minneapolis, Minnesota, on 12 August 1909. He joined North American Aviation, Inc. (now Boeing North American, Inc.) in 1936 at the age of 27. He began his all important and extremely productive career as a mechanical draftsman. Almost immediately, Spivak's extensive education in aeronautical engineering and his hardworking demeanor began to shine through. He steadily moved up the company's ranks and in January 1944, just eight years after he was hired, he became division chief engineer at North American's Kansas City plant on the Army Air Force's B-25 Mitchell and the Navy's PBJ Mitchell development and production programs. He also worked in concert with North American's Dallas plant on P-51 Mustangs.

After World War II he returned to work at North American's California facilities, where he took on numerous other engineering duties. These included work on the B-45 Tornado, AJ Savage, P/F-82 Twin Mustang, F-86 Sabre, FJ Fury, F-100 Super Sabre, F-107 Ultra Sabre, F-108 Rapier, and the B-70 Valkyrie to name a few. The B-1A came next, followed by the proposed Lockheed/Rockwell ATB, and the B-1B.

Mr. Spivak, one of America's true leaders in aeronautical and astronautical engineering, retired in 1974 at the age of 65. A few weeks later, due to his extensive engineering capabilities, he was called back to work. Ten years later, in 1984, he again retired at the age of 75. He ultimately racked up an amazing 48 years with North American Aviation and its successor companies. Still working today as a broker and realtor in Littlerock, he resides in Llano, California. He is 89 years old.

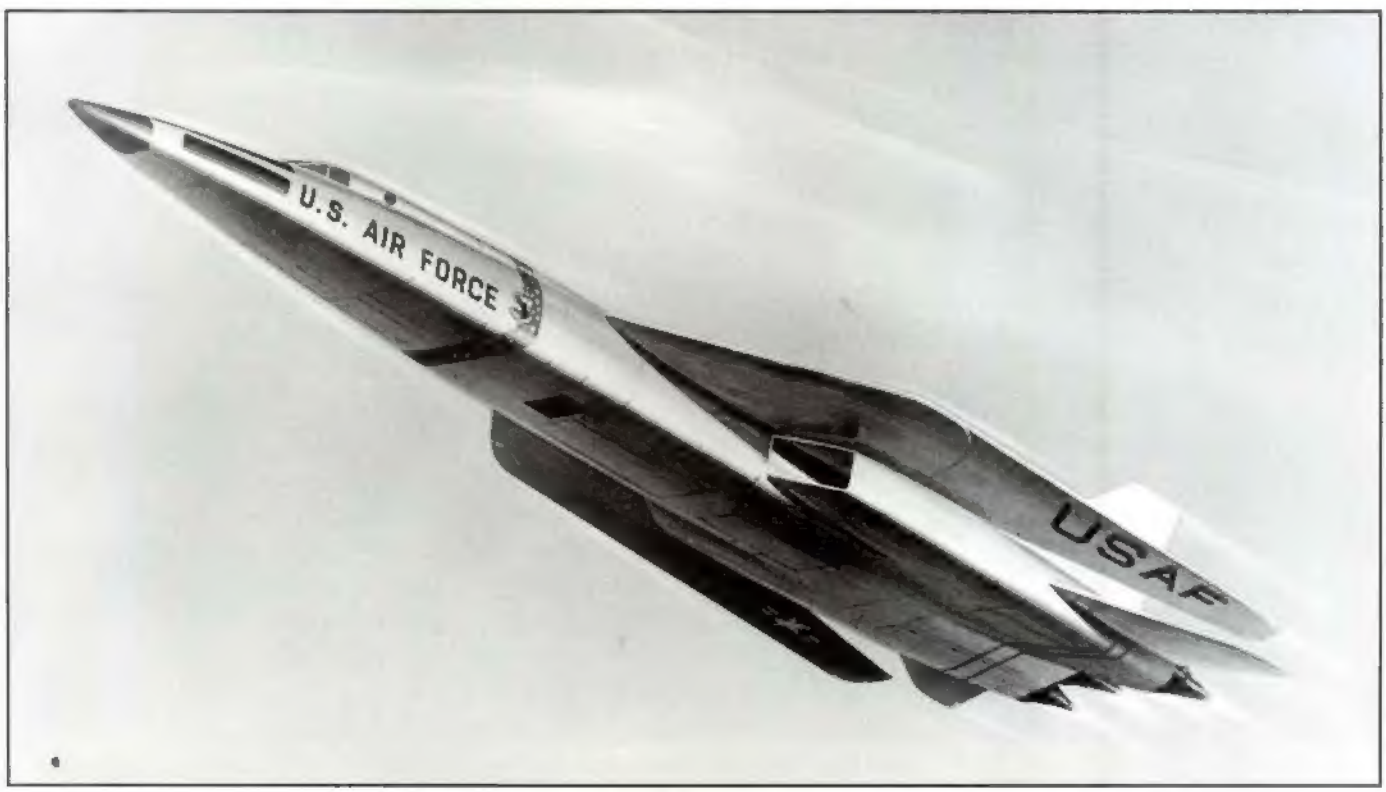
ACRONYMS, ACRONYMS

A FIST FULL OF ACRONYMS

The Boeing North American B-1B Lancer is a multi-role, long-range bomber used by the US Air Force Air Combat Command (ACC). Having been originally designed for the Strategic Air Command (SAC), the B-1B ultimately emerged from an extremely lengthy development program loaded with state-of-the-art systems described by copious acronyms. Changing mission requirements drove an evolutionary development that spanned more than 20 years before the B-1B actually entered operational service. Yet today, more than 30 years after its basic beginnings, it is regarded as the backbone of the Air Force's fleet of precision bombardment aircraft. Fully capable of dealing an all-out nuclear punch, the B-1B is also fully optimized for conventional warfare.

The B-1B of today externally resembles the B-1A of yesterday, but it is a very different aircraft. Officially named Lancer, its crew members respectfully refer to it as the "Bone" (B-one).

The B-1B program can be traced all the way back to 1961 when Air Force planners conducted studies to find a replacement for the older models of the B-52. The North American B-70 Valkyrie was slated to ultimately replace the B-52, but the ability of its high-altitude, high-speed design to survive in combat came into question in view of advances in Russian air defenses, principally improved radar acquisition and surface-to-air missile (SAM) technologies. With the downing of Francis Gary "Frank" Powers' Lockheed U-2 on 1 May 1960, to one of those very same Russian SAMs, the high-altitude, high-speed penetration of Soviet airspace became mute. Moreover, with the confirmation of operational MiG-25s capable of Mach 2.8



With its swing wings swept full-aft while it climbs up and away in full-afterburner following weapons delivery, this is one of many design configurations for North American's proposed AMPSS (Advanced Manned Penetrating Strategic System) aircraft studies that culminated in the early-1960s. (Boeing North American)

This D481-33 design configuration for the subsequent AMSA (Advanced Manned Strategic Aircraft) featured cheek-type engine air inlets on either side of the fuselage and fuselage-mounted horizontal stabilizers. The cockpit canopy framework and circular window aft of it are reminiscent of NAA's canceled F-108 Rapier—a proposed Long Range Interceptor (LRI), that was axed in September 1959. (Boeing North American)

Still another AMSA design study shows -33 characteristics, but with its horizontal stabilizer placed well aft on its empennage, or tail group. It also shows a widened fuselage for increased internal volume. (Boeing North American)

and the ability to reach altitudes near 80,000 feet, another type of manned bomber needed to be created. This and other considerations, especially the improved capabilities of long-range ballistic missiles launched from submarines or hardened missile silos, the B-70 program was cut to a two-aircraft experimental flight test program.

The "whiz kids" brought in by the new Secretary of Defense, Robert S. McNamara, brought with them an increased focus on cost effectiveness. This gave rise to a concurrence amongst high ranking officials within the Department of Defense (DoD) and Congress that ballistic missiles might have an edge over any new bomber in initial survivability and ability to deliver nuclear warheads on target. The per unit procurement costs for any presupposed next generation bomber was ten times that of a ballistic missile. The B-70, and all other manned bombers under consideration, failed to pass the whiz-kids' muster, and was canceled.

Yet, in the eyes of Air Force planners, a new manned bomber was indispensable. Regardless of the B-70's cancellation, during the early 1960s planners still believed that manned bombers had significant capabilities that could not be equaled by ballistic missiles. These included:

1. The capability of striking any type of target, especially those requiring great accuracy.

2. The ability to provide real-time bomb damage assessment and to

re-strike the same target again if necessary.

3. The use of visual deterrence through ground and airborne alert, believable pre-launch survivability, and the ability to convince a potential enemy that American deterrence was in place and ready to act.

4. The ability to project controlled, measured responses to conflicts at levels less than all-out nuclear war, a power projection that could defuse a potentially catastrophic incident.

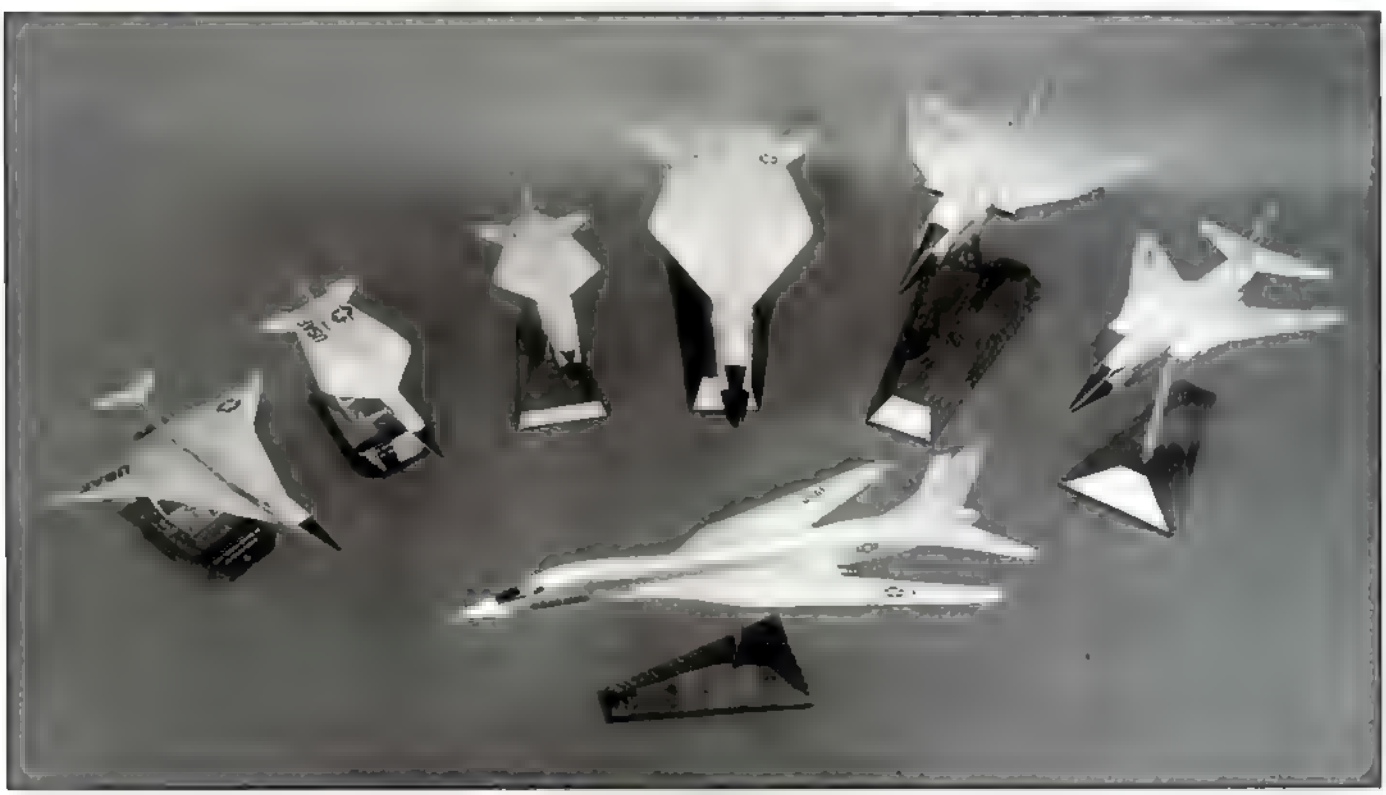
5. The ability to provide a highly visible show of national resolve.

The main objective of manned bomber studies during the early 1960s was to define the requirements for a cost effective replacement for the B-52. Studies leading to the original B-1A program, which officially began on 5 June 1970, had such acronyms as SLAB (subsonic low altitude bomber); ERSA(S) (extended range strategic aircraft (system)); LAMP (low altitude manned penetrator); AMP (advanced manned penetrator); AMPSS (advanced manned precision strike system); and finally AMSA (advanced manned strategic aircraft).

The latter aircraft's mission was to deter an all out nuclear exchange by 1) surviving an enemy's first strike, 2) successfully penetrating enemy defenses, and 3) accurately delivering lay-down (general purpose conventional bombs) and offset (chemical) weapons on enemy industrial and military targets.

Project Forecast

Advances in warplane technologies since the introduction of the first operational B-52s in 1955 resulted in many alternate schemes being investigated, such as supersonic penetration, subsonic penetration, and even some fairly radical V/STOL (vertical/short takeoff and landing) aircraft. The Project Forecast study was conducted in 1963 to examine the issue of deterrence, and the vehicle, or vehicles, with which to implement deterrence policy. One conclusion was that the manned bomber, flying at high speed and low altitude, with suitable electronic countermeasures (ECM), electronic counter-countermeasures (ECCM), and radar cross section (RCS) reduction enhancements, could be quite survivable in the air



With a model of the D481-39 version of the B-1A centered at bottom, a flock of earlier design configurations are showcased. Here, shown left to right, are some examples of the SLAB, ERSA, LAMP, AMP and AMPSS schemes as they progressed throughout the early-1960s. In the end, it was the D481-55B design configuration that was finalized for B-1A numbers one through three. (Boeing North American)

defense environments assumed into the 1990s.

In addition to its own in-house manned bomber studies, North American Aviation, Inc. (later North American Rockwell, then Rockwell International, now Boeing North American) participated in the government-funded LAMP and AMPSS conceptual design studies that grew out of Project Forecast. LAMP looked at long endurance standoff missile launchers, while AMPSS considered several configurations of manned penetrator-type aircraft designed to specific range and payload requirements.

The SLAB study, completed in 1961, centered around a subsonic fixed-wing bomber with an 11,000 nm range (including 4,300 nm at low altitude), a payload of 12,000 pounds, and a gross takeoff weight of 500,000 pounds. The ERSA(S) study, featuring a variable-geometry wing configuration, called for a subsonic 600,000 pound gross weight aircraft able to carry a 10,000 pound payload 8,750 nm, including 2,500 nm at an altitude of 500 feet.

The LAMP study came next investigating high endurance (lengthy on-station or loiter time) standoff missile launching aircraft, and was completed in August 1963. It called for an aircraft with a 350,000 pound gross takeoff weight carrying a 20,000 pound payload 6,200 nm, including 2,000 nm at low altitude.

The AMP study ran from November 1963 through January 1964, and has sometimes been referred to as the pre-, pre-AMSA study. It was short-lived and quickly evolved into the AMPSS study which ran from May through August 1964. The AMPSS looked at several configurations of low-altitude penetrators as well as high-speed, high-altitude penetrators sized to specific range (up to 6,000 nm) and payload (up to 50,000 pound) requirements. In November 1964 it became the basis for a request for proposals (RFP) from the Air Force for a new advanced manned strategic aircraft (AMSA). The study reached several general conclusions that

The B-1A engineering mockup was thoroughly inspected by the Air Force during the last half of october 1971, with no major deficiencies being recorded, although there were 297 Requests for Clarifications (RFA) written. The mockup was very detailed—the left wing could pivot to various sweep angles, and the weapons bay doors could open and close. (Boeing North American)

ultimately led to the establishing of AMSA requirements, including:

1. Standoff missile launchers (SOML) must be large aircraft, on the order of 500,000 to 670,000 pounds gross weight, in order to carry a significant fuel and weapons quantity. This size would be observable by AWACS-type aircraft and picket ships, which then could direct attacks by long-range interceptors and ship-launched surface-to-air missiles. In addition, the basic SOML weapon—the standoff missile—at that time had built-in inaccuracies resulting from the inability to precisely fix the launch point, and hence the target position in the missile's guidance system. These limitations curtailed any extensive SOML development.

2. A highly swept wing was necessary for the AMPSS low altitude, high speed mission to achieve drag reduction and gust alleviation. Since the AMPSS mission also required short takeoff and landing distances, and economical cruise performance, a variable-geometry wing was selected as the AMPSS point design. Because of reduced stiffness requirements in its highly swept position, the variable-geometry wing aircraft was found to weigh (and cost) less than a fixed wing aircraft.

3. For alternate missions at high altitude and speeds of Mach 2 or greater, a fixed wing aircraft proved to be the lighter and less costly.

4. Dual mission capability (low/high altitude penetration) was a desirable feature to retain. Penalties associated with high altitude supersonic flight were offset by gains in mission flexibility and tactical options of diluting the concentration of enemy air defenses.

5. A crew of four—pilot, copilot, offensive system operator, and defensive system operator—was found to be necessary for crew relief during loiter, and to meet the

Made mostly out of wood, the B-1A mockup featured a fully-exposed interior that could be viewed from its right side. Note the raised walkway on the opposite side, and the open weapons bay doors. (Boeing North American)

Numerous mockups of B-1A systems components were created. This one, with a Air Force officer seated, is a mockup of the B-1A's Offensive Systems Operator (OSO) station on the right-hand side of the aircraft, opposite the Defensive Systems Operator (DSO) station. The screen at top center is a multi-function display (MFD) that was to display data from the B-1A's Electroptical Viewing System (EVS), consisting of Forward-Looking Infrared (FLIR), low light level television, and alphanumeric information. The round screen below the MFD is the viewing screen for the forward looking radar. In front of the operator is the alphanumeric display and keyboard used for interfacing with computers. The operator's hand is on the control stick for the forward looking radar. (Boeing North American)

intense workload during penetration. Simultaneous ejection of all crew members was considered highly desirable for safe low-level escape.

So with the general parameters and a base point configuration established through the earlier AMP/AMPSS studies (1963-64), the Air Force launched the considerably more comprehensive AMSA study in 1965. This study lasted four years and consisted of 16 staggered study tasks. Three airframe contractors, The Boeing Company, General Dynamics Corporation, and North American Aviation pursued the 16 tasks in parallel.

Simultaneously, the Air Force funded avionics and engine studies by other contractors. Expecting a "total system performance responsibility" clause in any resultant development contract, North American drafted working agreements with potential avionics and powerplant contractors. These would survive in the same essen-

tial form with the eventual B-1 associate contractor relationships.

Independently, in early 1964, Boeing had begun development of the nuclear-armed AGM-69A Short Range Attack Missile (SRAM) which was to become the primary penetration and/or standoff weapon for the proposed AMSA.

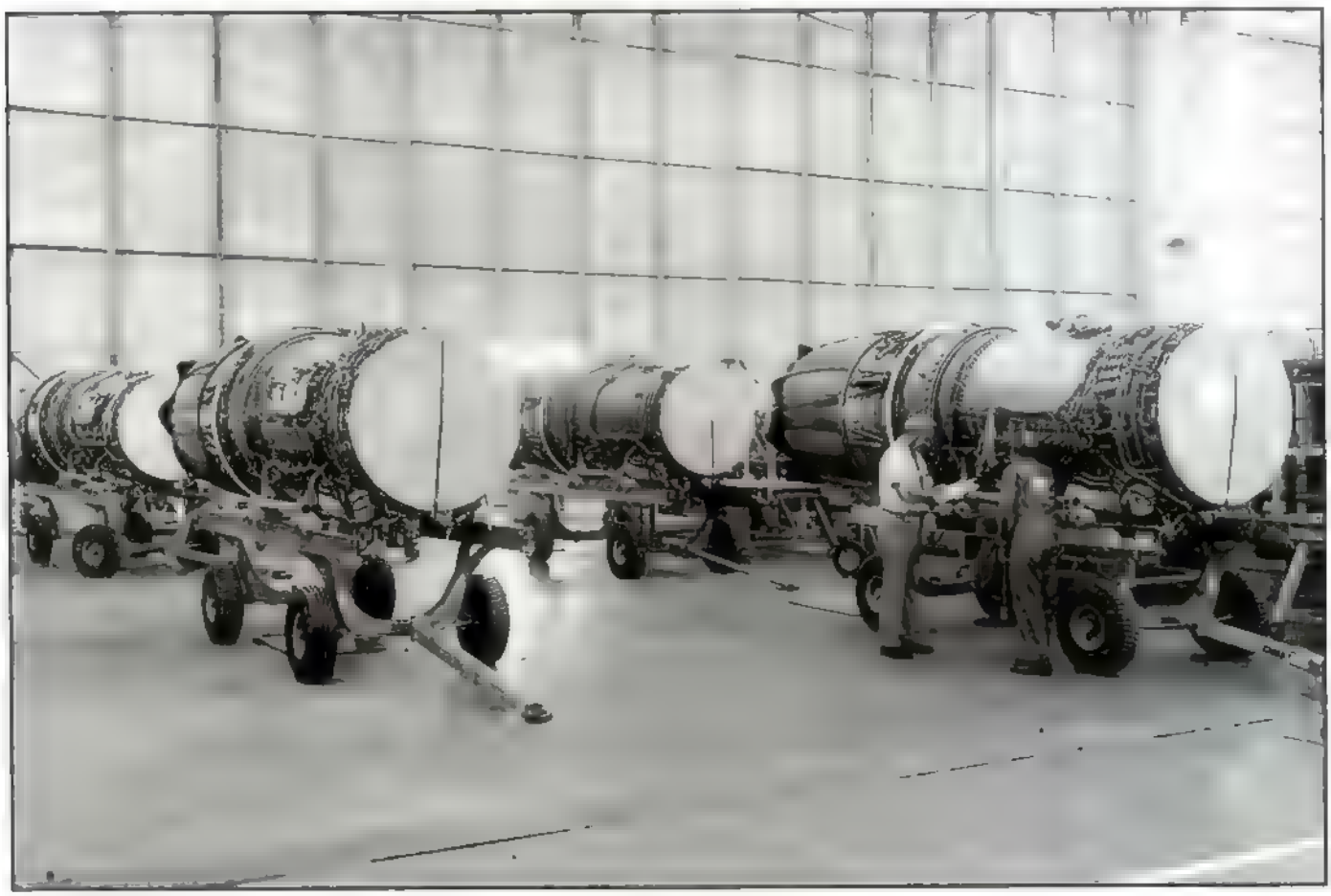
Configuration Selection

Requirements unique to the low level penetration mission became the drivers for the configurations that advanced from the 1963 AMP studies to the 1969 AMSA proposal configuration. North American Rockwell design number D481-39 (pre-, pre-final configuration) was submitted in 1969, concluding the four-year study effort. The principal requirements that impacted the eventual configuration selection were:

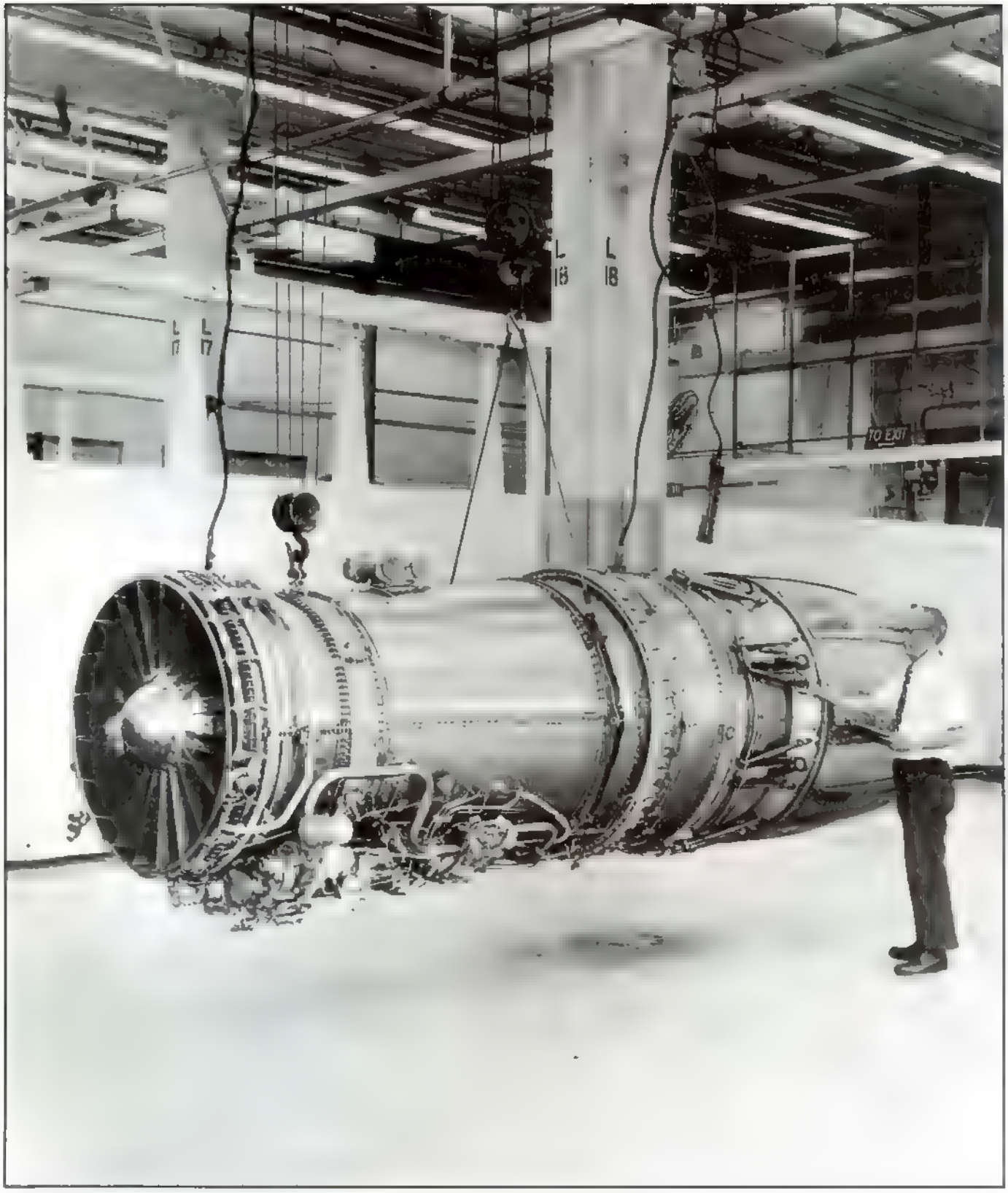
- Survivability
  - Initial and en route
  - Hardening
  - Fast escape—quick reaction
  - Active defense
- Weapon delivery
- High subsonic, low altitude flight
- Ride quality and crew escape
- Alternate supersonic mission
- Radar cross section/infrared suppression
- Damage tolerant structure

Although the need for en-route survivability was graphically demonstrated by the U-2 incident in May 1960, another vital element is initial survivability. To this end, one major goal of America's three-pronged Triad concept is to dilute the effectiveness of a first strike by diverse deployment options: manned bombers, land-based missiles, and submarine-based missiles in multiple locations.

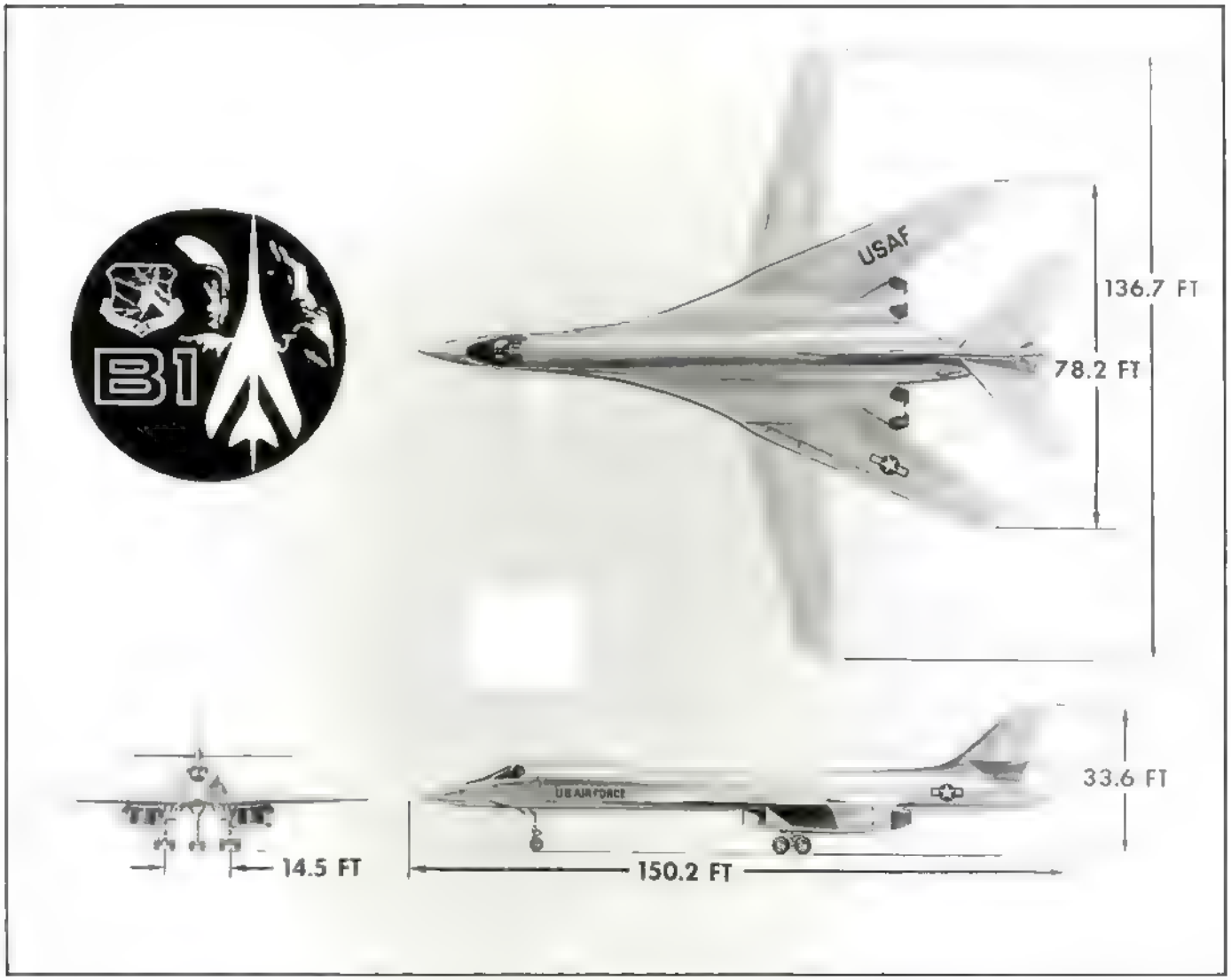
Initial survivability can be further enhanced through 1) hardening—the ability to absorb the strike, 2) dispersal to prevent or inhibit targeting, and 3) escape by quick reaction to warning. And so, the emphasis was on hardening the design



The fourth YF101 flight test engine arrived at Rockwell's Site 3, Building 301 facility at Air Force Plant 42 in Palmdale in May 1974. Rated in the 30,000 pounds-thrust class, four YF101s ultimately propelled B-1A number two to a best-ever speed of Mach 2.22 on 5 October 1978. (General Electric Aircraft Engine Group)



Photographed while still at GE's Lynn, Massachusetts, facility in mid-1972, this is the first XF101-GE-100 turbofan engine to be used for performance testing. It was subsequently shipped to the Air Force's Arnold Engineering Development Center (AEDC) at Tullahoma, Tennessee, in September 1972 where it underwent a comprehensive Preliminary Flight Rating Test (PFRT). (General Electric Aircraft Engine Group)



The general arrangement drawing of the B-1A (D481-55B) as it was released to the public in 1971. Although similar in appearance to today's B-1B, the B-1A was a very different aircraft. (Boeing North American)

and fast escape for a new AMSA—the B-1A.

Hardening, as applied to bombardment aircraft, can be provided by 1) sheltered basing, 2) designing aircraft structures to withstand overpressures and thermal pulses associated with nuclear detonations, and 3) an electrical/electronics configuration that can withstand the electromagnetic pulse (EMP) and other radiation generated by nuclear explosions.

Sheltered basing is a useful survival technique for smaller aircraft such as the F-117A Nighthawk stealth fighter. However, it is far less cost-effective, or practical, to provide hardened basing for large bombers. The candidate replacements for the B-52 studied during the 1961-69 time period had gross takeoff weights, in one case, of over 600,000 pounds, but seldom less than 300,000 pounds. Hardening structures that could shelter a large bomber would be very expensive, absorb excessive facility resources, and be more easily targeted. In fact, they would become first-strike targets.

A more practical alternative was hardening the aircraft structure itself. In hardening aircraft structures, skin thickness and the strength of load-carrying members are designed to withstand overpressures, gust loads, and the accompanying thermal pulse generated by a nuclear blast. Unlike hardened shelters, these measure are also useful while the aircraft is in flight.

The radiant energy of the thermal pulse, which generally lasts for several seconds, interacts with all

exposed aircraft surfaces, producing a short duration temperature spike. Thin skin structures fabricated from unconventional materials (composites, ablative material, radome materials, adhesively bonded structure), and the crew station are of primary concern for thermal hardening. Next comes a shock wave propagating radially away from the burst point that behaves like a moving wall of highly compressed air, consisting of an overpressure pulse accompanied by a strong wind, or gust.

The first response is the crushing of lightweight structures due to the loads associated with the overpressure pulse. The duration of the reflected pressure is short, about the time it takes the blast wave to engulf the structure. Structures such as fairings, radomes, access panels, leading and trailing edges of wings and stabilizers, thin skin panels, frames, and stringers have a high natural frequency and are, therefore, sensitive to high-peak short-duration loadings. The second response is the gust velocity producing abrupt changes in aerodynamic lift and drag loads resulting in shearing and bending forces on elements of the primary structural components such as the wing

In an ongoing effort to sell the B-1A to the Carter Administration, this model comparison was made for a political show-and-tell session. A B-1A is in the center with a Tu-160 Blackjack (bottom) and a Tu-26 Backfire displayed on either side. While the B-1A did not enter into production, the two Soviet aircraft did. The resemblance between the American B-1A and the Russian Tu-160 is obvious. (Boeing North American)

The almost finished B-1A number one was moved out of its manufacturing area to the paint shop in mid-1974. There it was painted in a gloss white paint scheme which was retained until the advent of the B-1B program in 1981, when it was re-painted in B-1B camouflage. B-1A number one was not used in the B-1B flight test program. The aircraft was eventually disassembled and transported to Griffiss AFB, New York, where it was used as a radar cross-section test bed. (Boeing North American)

and stabilizer box (spars) and the fuselage (longerons). The designers must consider these phenomena while seeking a balance between hardness and performance.

During 1967, as North American Aviation continued its engineering studies on the B-1A, it merged with the Rockwell International Corporation to become North American Rockwell (NAR).

Defensive armament for the new aircraft, in the form of radar-directed automatic guns/cannons, long-range cruise missile decoys, or bomber defense missiles was a continuing trade-off subject during the AMSA study. In this case, trading offensive weapons for active defensive weapons became a spirited issue. The predicted en-route survivability features of the proposed manned penetrator—high-speed, low altitude, terrain masking; electronic countermeasures; infrared countermeasures; low radar cross section; low infrared signature; and defense avoidance maneuvers were sufficiently effective to preclude the need for any active defenses. Hence, the AMSA study configuration did not carry gun armament or defensive missiles.

To be an effective deterrent, offensive weapons deployed by a strategic aircraft must be of such yield and accuracy as to have a destructive probability that is unaccept-

able to the enemy. The accuracy of missiles such as the AGM-86B/C air launched cruise missile, AGM-129A advanced cruise missile, Trident submarine-launched ballistic missiles, and intercontinental ballistic missiles (ICBM) such as the Lockheed Martin LGM-118A Peacekeeper have from a one nautical mile circular error probability (CEP) to approximately one-quarter of a mile. The modern manned bomber may reasonably be expected to achieve a weapon CEP of one-quarter to one-tenth of a mile for air-to-ground missiles (AGM), and a few hundred feet for laydown weapons (gravity free fall bombs).

The superior accuracy of bomber-launched weapons equates to vastly improved kill probabilities. As an example, 17 long range missiles (ICBMs and/or SLBMs), each with a 200 kiloton warhead, would be required to achieve a 0.99% kill probability against a single 100 psi hardened missile silo. Only a single bomber-launched AGM or laydown weapon (with the same yield) would be required. This illustrates the strategic need for manned bombers.

Shown left to right are Charlie Bock, Rockwell B-1A chief pilot; Gen. Russ Dougherty, commander in chief, Air Force/SAC; Dick Abrams, Rockwell B-1A flight test engineer; Maj. Fred Black, Air Force B-1A test pilot; and Maj. George Jansen, Air Force B-1A test pilot. These five men were very instrumental in the success of the B-1A flight test program. (Boeing North American)

ENGINEERING THE B-1A

CREATING THE ADVANCED MANNED STRATEGIC AIRCRAFT

The development of the AMSA was such a large undertaking that North American Rockwell formed a separate division headed by R. F. Walker, division president and B-1 general manager. His deputy was executive vice president R. E. Greer. These two men reported to North American Rockwell president Robert Anderson. Eight division directors reported to Walker and Greer, including: W. A. Spivak, vice president of B-1 research and engineering; H. W. Elkin, division director of B-1 market development; D. L. Peitzke, division director of B-1 subcontract management; R. H. Kemp, division director of B-1 program operations; E. L. Caustin, division director of B-1 quality and reliability assurance; G.

Whenever a contractor gets prepared for a potentially large aircraft production program, it often establishes an entire division within its company to address the wide array of program requirements. It was no different for Rockwell. In mid-1970, after Rockwell won the B-1 competition, it established a B-1 Division at its Los Angeles, California, plant. Headed by B-1 Division general manager R. F. Walker and deputy general manager R. E. Greer, B-1 program management personnel are spotlighted. Note the photograph of W. A. Spivak (vice president of research and engineering) in the left center frame. (Boeing North American)

Flight test crews for new military aircraft can be selected by the manufacturer and user service years before the aircraft appears, as happened with the original B-1A. For Rockwell, the originally selected B-1A flight test crew was made up of Charlie Bock, chief pilot; Doug Benefield, project pilot; and Dick Abrams, flight engineer. For the Air Force, original flight test personnel were Col. Ted Sturmthal, chief pilot; Lt. Col. Ed McDowell, project pilot; and Ken Martin, flight engineer. (Boeing North American)

Stroh, vice president of B-1 manufacturing; J. Van Tatenhove, vice president of B-1 business management; and J. J. Edwards, general manager of B-1 division programs. Six others including R. W. Ferren, flight test manager; J. F. McCarthy, Jr., systems engineering vice president; H. A. Evans, engineering chief engineer; D. B. Rogerson, project engineering manager; R. H. Barron, technical operations manager; and D. G. Whitman, advanced design manager; also reported to Spivak. R. A. Stacey of manufacturing, and C. G. Adams of contracts management, reported to Stroh and Van Tatenhove, respectively. To round out the 19 men who managed the B-1 division, three others, E. L. Bishop, planning and control; D. C. Lefler, contract management; and E. Green, configuration and data management; reported to Kemp.

On 3 November 1969, after the completion of the AMSA studies, the Air Force released an RFP for what would become the B-1A. Boeing, General Dynamics, and North American Rockwell responded to the RFP sixty days later, a typical response period for a large government contract.

By the time North American Rockwell submitted its proposal to the Air Force in January 1970, the design had metamorphosed from the pre-pre-final D481-39 configuration, into the pre-final D481-53, and finally to the D481-55B configuration. The most obvious external changes were that the aircraft's horizontal stabilizer had moved to a mid-span location on the vertical stabilizer, and the tail cone was re-shaped to a less conical section that increased equipment volume and improved airflow characteristics by reducing boat tail drag. Further, the fuselage-to-wing glove juncture was

In mid-1975, with the number one B-1A taking center stage, a General Dynamics FB-111A (left) and a Boeing B-52G escort what was to be America's next strategic bomber. Today, some 28 years later, none of the aircraft in this photograph are in service. A photograph now would probably illustrate a B-1B on center stage, escorted by a B-52H and a Northrop Grumman B-2A—the only strategic bombers in the current inventory. (Boeing North American)

blended more gradually, resulting in a slightly reduced radar return and a thicker wing section that allowed a stiffer structure.

The Air Force examined the engineering data submitted by Boeing, General Dynamics, and North American Rockwell in a little more than four months. On 5 June 1970, North American Rockwell was declared the winner and awarded a cost plus incentive fee contract (F33657-70-C-0800) to design and build the B-1A. The contract included two non-flying structural test airframes and five flyable prototypes.

Rockwell's original B-1A chief pilot Charles C. "Charlie" Bock, Jr., is a retired Air Force Colonel. By the time President Carter canceled the B-1A production program in mid-1977, he had flown more than 210 hours in the three B-1As. An Air Force test pilot since mid-1954 (he flew such aircraft as the YF-12A, SR-71A, and B-58A), he had more than 7,800 flying hours at the time. Bock joined Rockwell in April 1973 and was made B-1A chief test pilot in May 1974. He was born on 24 November 1925 in Council Bluffs, Iowa. (Boeing North American)

Simultaneously, General Electric Aircraft Engines received a cost plus incentive fee (CPIF) contract (F33657-70-C-0801) to design and

Tommie Douglas "Doug" Benefield was hired by Rockwell in June 1974 and was appointed as B-1A project pilot. He had joined the Air Force in July 1949 and became a Lt. Col. before he retired in July 1973. Benefield had served as a Air Force test pilot since September 1955, and by March 1977, had amassed 10,270 flying hours in many different aircraft—186 of those hours in the three B-1A aircraft. Unfortunately on 29 August 1984, while flying B-1A number two as the first B-1B flight test aircraft, Tommie Douglas "Doug" Benefield died from injuries suffered in the crash of the aircraft. He was born on 14 February 1929 in Rison, Arizona. (Boeing North American)

With its variable geometry wings swept full-aft to 67.5°, B-1A number one flies high above the Pacific Ocean on its 12th test flight out of Edwards AFB on 12 July 1975. In this configuration, the aircraft could fly at Mach 2+ at altitude, and at Mach 0.95 only 200 feet above ground level (AGL). (Boeing North American)

build a new augmented (afterburning) 30,000 pounds-thrust turbofan engine. The contract included a full-scale engineering mockup of the F101-GE-100 engine, a pair of prototype XF101-GE-100 engines for development tests, and 40 service test YF101-GE-100 engines.

As an interim measure while all of the studies were progressing, the remaining B-52G and B-52H aircraft were strengthened to bear up under the structural loads of low altitude penetration. This action, of course, was the understandable response to the high altitude threat posed by advanced Soviet radar networks and

Showing its landing configuration—trailing edge wing flaps, leading edge wing slats and landing gear extended—the first B-1A lands at Edwards after its 12th test flight. B-1A-1 completed 24 test flights in 1975—the only B-1A flying during that year. (Boeing North American)

This view of the third B-1A taking off for the first time from Palmdale, on April Fool's Day 1976, illustrates just how close together, and how near aircraft centerline, the two dual engine nacelles are placed. This configuration was engineered to keep as much thrust as possible close to the B-1A's centerline in case of an engine failure. In this way, aircraft asymmetric thrust levels would remain within acceptable limits. (Boeing North American)

SAMs. The General Dynamics/Convair F-111A (WS-324A), designed as a low- to medium-altitude multipurpose tactical fighter bomber, was altered to serve as the FB-111A (WS-129A) "interim" strategic bomber. These modifications occurred between the retirement of the B-58 (WS-102A) in early 1970 and the appearance of the first B-1A (WS-139A) in late 1974.

Mockup Inspection

A little over 16 months after contract award, the B-1 full-scale engineering mockup was given a thorough going over by the Air Force 689 Engineering Board. The 208 member B-1A mockup review team met at the B-1 Division's Los Angeles facility from 18-31October.

During the inspections of the crew station, avionics compartments, weapon bays, landing gear and so on, the review team wrote 297

With about 120,000 pounds-thrust being generated by its four YF101-GE-100 turbofan engines, B-1A-4 lifts-off from Palmdale for its first flight on 14 February 1979. Although B-1A-3 was outfitted with the B-1A prototype offensive avionics system, B-1A-4 was the only B-1A aircraft to be produced with the full defensive and offensive avionics suites. During B-1B flight testing, it was also the only B-1A to be fitted with the complete B-1B defensive and offensive avionics suites. (Boeing North American)

request for alteration (RFA) reports. North American was able to resolve 257 of these on the spot, and the remaining 40 RFAs were resolved by early 1972. Of the 297 RFAs, 93 related to aircraft or systems maintainability; 48 concerned safety issues; 138 were operational issues; 10 were logistics or support; and eight were in the areas of survivability and vulnerability.

Rollout and First Flight

B-1A number one, also known as air vehicle number one (AV/1), made its long awaited public debut on 26 October 1974, at Air Force Plant 42, Site 3, Palmdale, California. As planned, after the huge doors of adjoining Buildings 301 and 301A had opened, the first B-1A prototype (74-0158) rolled outward into the sun's light. For more than 13 years the Strategic Air Command had been waiting for a viable B-52 replacement. And with the B-1A it believed it finally had one.

But as political climate and strategic bombardment philosophies changed, it became obvious that the Air Force would not field a fleet of operational B-1As. Still, from this

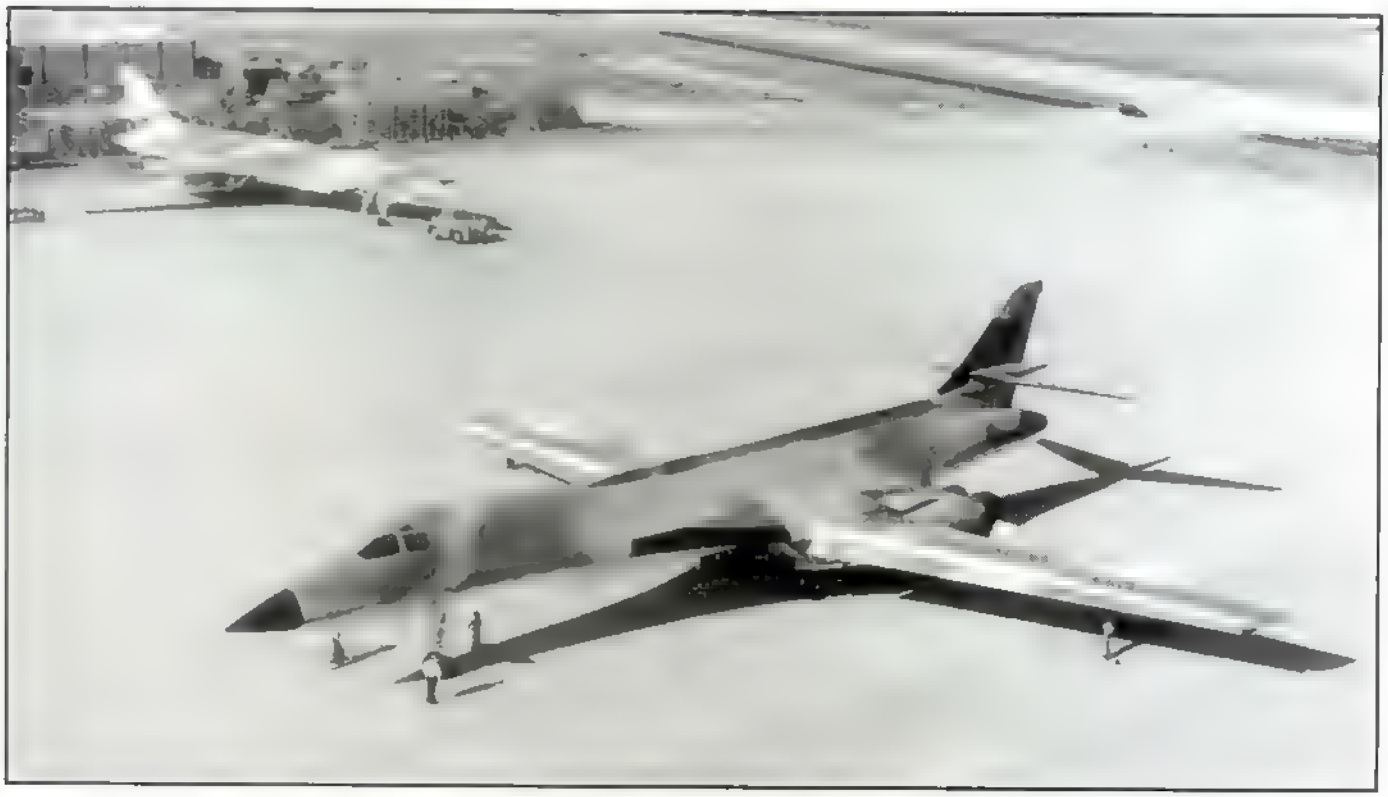
In this close-up, head-on view of B-1A-4 on the ramp at Edwards, Humphrey Bogart's famed line, "Here's looking at you kid," to Lauren Bacall in the movie classic Casablanca comes to mind. And, as far as large and heavy bomber aircraft go, the B-1 is a looker. (Boeing North American)

very same 301/301A building complex that had produced the two XB-70A Valkyries ten years earlier, another three B-1As would emerge.

Less than two months after roll out, AV/1 made its first flight on 23 December 1974. Piloted by B-1 Division chief test pilot Charles C. "Charlie" Bock, Jr., co-piloted by Air Force Col. Emil "Ted" Sturmthal (director of the B-1 Joint Test Force), with Richard "Dick" Abrams serving as B-1 Division flight test engineer, the B-1A successfully completed a one hour and 18 minute flight from Palmdale to the Air Force Flight Test Center at Edwards, about 30 miles to the north. It was the only B-1A flight in 1974.

There were 24 B-1A flights in 1975.

The second B-1A underwent eight months of static testing before it made its first flight on 14 June 1976. (Boeing North American)



Spoilers deployed and dressed up in a new desert camouflage scheme similar to B-1A-4 in the background, B-1A-3 is being prepared for yet another of its 138 test hops. After the B-1A had been canceled B-1A-3 served, among other things, as a static test bed for B61 nuclear bomb ejections. Open weapons bays are noteworthy. (Boeing North American)

The number three B-1A on a low-level flight near "The Ranch" during Bomber Penetration Evaluation (BPE), tests somewhere within the restricted Nellis AFB, Nevada, test range complex in early-1970. It uses its terrain following system to penetrate this river-filled canyon at a very low-level and high-speed. (Boeing North American)

During more than 100 hours of flight testing, B-1A number one demonstrated virtually all the critical design points, including high-speed, low-altitude penetration, flying and handling qualities, heavyweight takeoffs, supersonic speed, and compatibility with Boeing KC-135A Stratotankers in aerial refueling maneuvers. Other accomplishments included flutter evaluations, weapons bay door operations while carrying eight inert SRAM shapes, manual terrain following radar evaluations, and assisted and unassisted YF101 engine air starts.

During 1975 three other pilots besides Charlie Bock and Ted Sturmthal qualified in the B-1A: Tommie Douglas "Doug" Benefield, North American Aviation; Lt. Col. Ed McDowell, US Air Force; and Maj. George W. Larson, Jr., US Air Force. A civilian employee of the Air Force, Pat Sharp, also flew in the B-1 as flight test engineer.

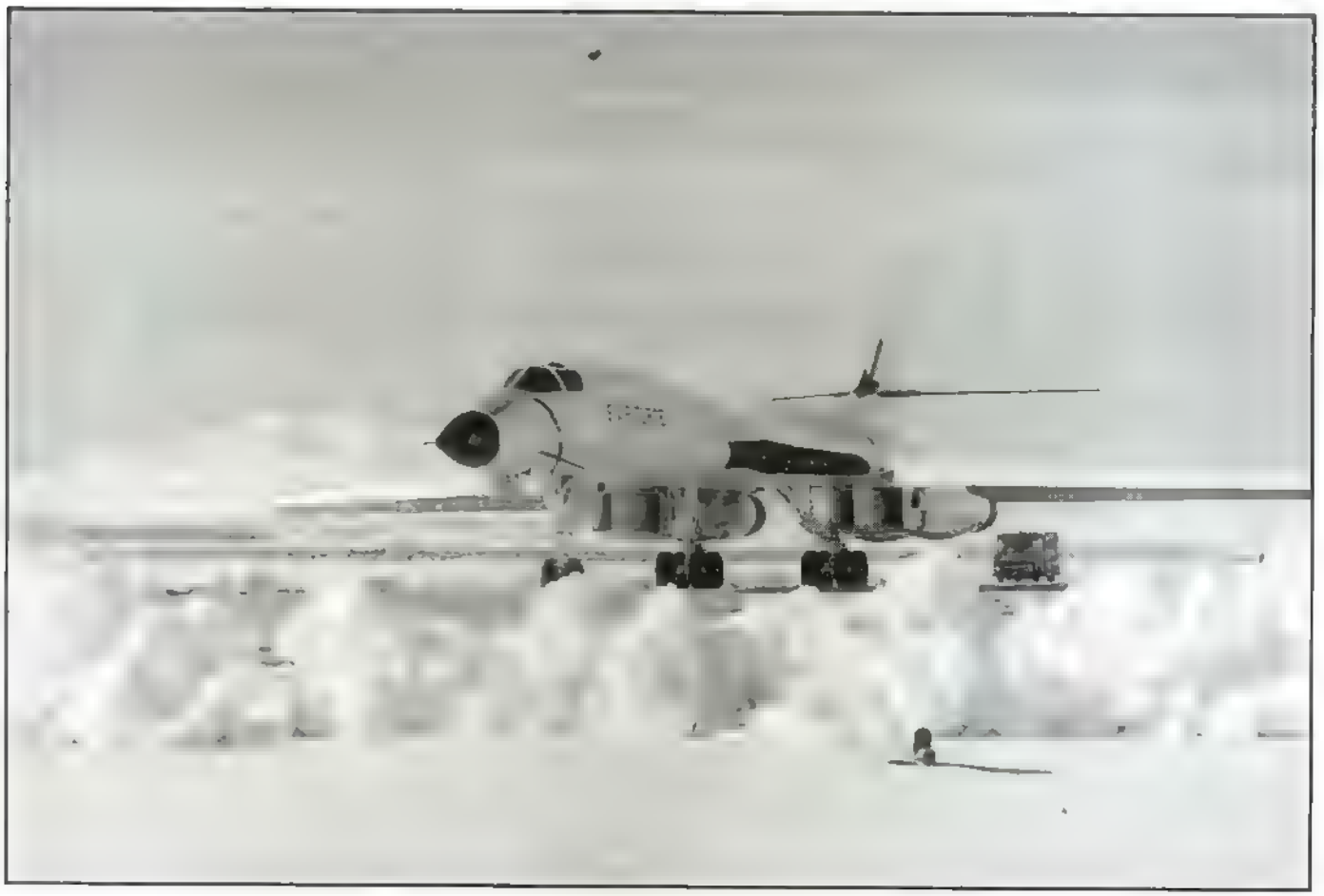
Highlights of the B-1A flights during 1975 included:

- 18 March – wings cycled in flight from the full-forward 15° position to the full aft position of 67.5° for the first time.

- 10 April – first supersonic flight to Mach 1.0,5 and first inflight refueling.
- 21 April – first sustained supersonic flight (Mach 1.06 for 42 minutes).
- 30 April – heavy weight takeoff (360,000 pounds).
- 19 September – first low-level flight, 500 feet above the Pacific Ocean at Mach 0.75.
- 9 October – High-Speed low-altitude flight (Mach 0.85 at 500 feet).
- 11 November – lowest B-1 flight, series of calibration tests 200 feet above the Edwards runway at various speeds from 190 mph to Mach 0.83.
- 26 November – fastest and highest flight in 1975, Mach 1.60 (about 1,070 mph) at 50,000 feet.

The first B-1A completed two additional flights in early 1976 before it was joined on 1 April 1976 by B-1A number three. Air Vehicle 3's first flight lasted fours hours and 54 minutes, again from Palmdale to Edwards. The third B-1A flew before AV/2 because the latter spent eight months undergoing static structural airframe tests before it was readied for its first flight. The second B-1A finally made its first flight on 14 June 1976, a general shakedown flight from the Palmdale assembly facility to Edwards AFB.

By 21 September 1976 the first three B-1As had flown 63 flights, logging 339 hours and 55 minutes. During approximately 176,800 flight miles, a top speed of Mach 2.10 (1,350 mph) at 50,000 feet had been achieved (AV/1). The longest single flight lasted nine hours and 40 minutes (AV/3). Supersonic flight



It rarely snows at Palmdale, but when it does, it sure makes for some very interesting photography. Here, on 6 February 1979, B-1A-4 is surrounded by the white stuff as it performs a taxi test prior to its first flight eight days later. All new aircraft complete a lengthy series of low, medium, and high-speed taxi tests to make sure their nose wheel steering, wheel brakes, flaps, slats and the like are functioning properly before they are cleared for flight. (Boeing North American)

North American Rockwell B-1A Production

Serial Number	Rollout	First Flight	Final Disposition
74-0158	10-26-74	12-23-74	B-1A number one was dismantled and is used as a radar cross section and reflectivity test article at Rome Air Development Center, Griffiss AFB, New York
74-0159	05-11-76	06-14-76	Served as both B-1A and B-1B flight and performance test aircraft; it crashed to destruction 29 August 1984 while being tested as B-1B prototype number one
74-0160	01-16-76	03-26-76	Removed from flying status, B-1A number three is at Lowry AFB, Colorado, and is a weapons loading trainer
76-0174	12-78	02-14-79	Served as both B-1A and B-1B defensive and offensive avionics system test aircraft (B-1B prototype number two). The aircraft is on display at the Air Force Museum, Wright-Patterson AFB, Dayton, Ohio

time for the three aircraft totaled nine hours and nine minutes.

B-1A Powerplant

The B-1A test aircraft used four afterburning 30,000 pounds-thrust General Electric F101-GE-100 turbofan engines. General Electric supplied a single full-scale engineering mockup F101-GE-100 in June 1971. The first of two XF101-GE-100 engines ran for the first time in October 1971, and both were used for the type's preliminary flight rating tests. Forty pilot-production service test YF101-GE-100 engines were delivered to the B-1A program beginning in June 1973.

During July 1973, mounted within a simulated B-1A engine nacelle, two YF101s ran simultaneously for the first time at Rockwell's Santa

North American Rockwell B-1A Specifications

User Service:	United States Air Force, Strategic Air Command
Wing Span:	136 feet, 8.5 inches fully extended; 78 feet, 2.5 inches fully swept aft
Wing Area:	1,950 square feet (approximate)
Length:	150 feet, 2.5 inches with nose boom; 143 feet, 3.5 inches without nose boom
Height:	33 feet, 7.25 inches
Gross Weight:	389,800 pounds
Empty Weight:	143,000 pounds (approximate)
Payload:	75,000 pounds
Powerplant:	Four augmented General Electric 30,000 pounds-thrust class (29,850 lbf actual) YF101-GE-100 turbofan engines
Maximum Speed:	Mach 2.22 attained (B-1A number two); designed for Mach 2.0 at 50,000 feet
Crew:	Four: pilot, copilot, defensive systems operator and offensive systems operator (B-1A number four only)
Maximum Range:	6,100 miles (without in-flight refueling)

Susana, California, test facility. The first flight test YF101 was shipped to Palmdale in March 1974, and by the end of May the fourth YF101 flight test engine for the first B-1A was in hand.

General Electric's advanced concept F101-GE-100 turbofan was slightly more than 15 feet long, a bit over four feet and five inches in diameter, and weighed about 4,000 pounds dry. It used a nine-stage axial-flow compressor and a two-stage fan to achieve a bypass ratio of approximately two-to-one. Air flow was rated at 350 pounds per second. The engine used a one-stage high pressure turbine and a two-stage low pressure turbine. A mixed-flow type afterburner (augmentor) and an convergent/divergent exhaust nozzle were used.

The effective use of advanced technology enabled the new F101 to achieve nearly the same thrust as two of the then-current General Electric J79 turbojet engines that powered the B-58 and F-4. Yet the new engine had 25% lower fuel consumption and 30% less installed volume. It was also designed to require less maintenance, and to have a longer service life without major overhaul.

Following its first take off from Palmdale on 1 April 1976, B-1A-3 made a successful 4 hours and 54 minute first flight to Edwards AFB. A general shakedown of the aircraft and its systems was completed during the 2,500+ mile flight. Top speed on the flight was Mach 0.85, about 630 mph. It was piloted by Rockwell's Charlie Bock and co-piloted by Air Force Lt. Col. Ed McDowell. Rockwell's Dick Abrams served as flight test engineer and Air Force Lt. Col. Warren Brotnov was offensive systems operator. (Boeing North American)

The B-1A-4 flew 70 times and logged 378 flying hours during the B-1A flight test program, and later participated in the B-1B flight test program. After being repainted in its original white paint scheme, it now resides at the Air Force Museum at Wright-Patterson AFB, Ohio. (Boeing North American)

During its flight test program, B-1A-3 flew 138 flights for a total of 829.4 flying hours. Its longest flight was 10.95 hours. Although it was capable of reaching double-sonic speed, it only attained a maximum speed of Mach 1.4 or approximately 915 mph at 44,200 feet. (Boeing North American)

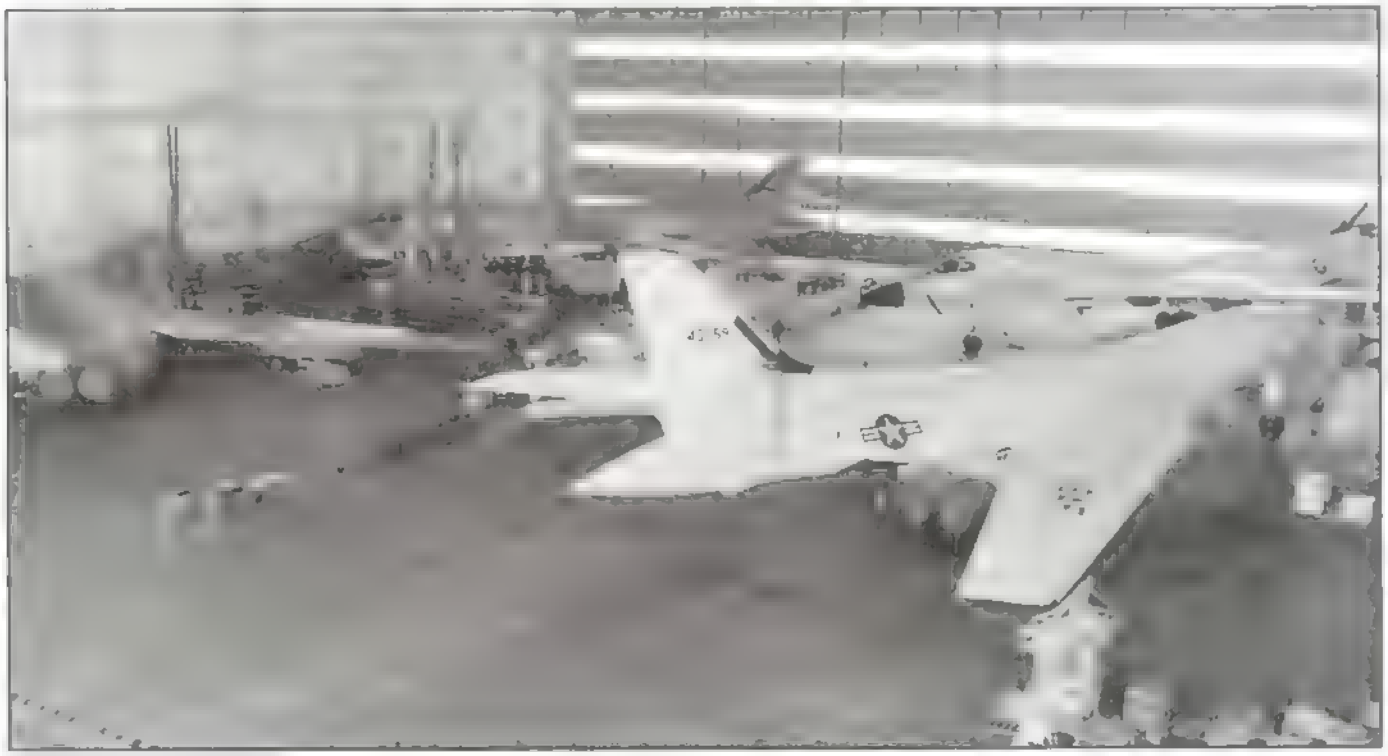
BAD TO THE BONE

CARTER BURIES THE BONE

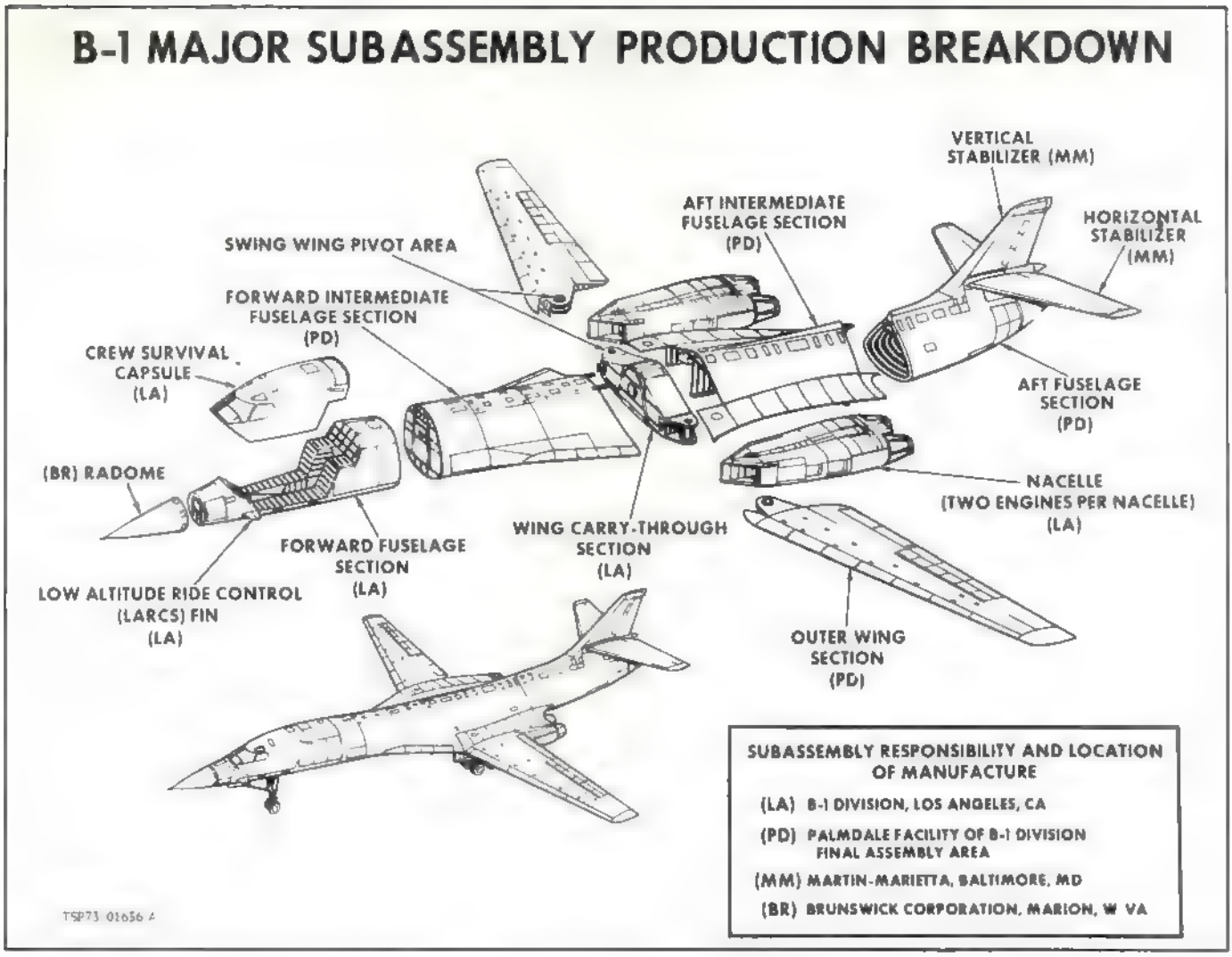
On 30 June 1977, President Carter canceled both the B-1A aircraft and the F101 engine production programs. Although B-1 research, development and flight test activities were authorized to be continued—at a very reduced level—using the three test aircraft, the B-1A program was, for the most part, dead. Hope still existed within the Air Force that a fourth B-1A aircraft, complete with the planned defensive and offensive avionics systems installed, would still be built. This would allow the program to demonstrate that the aircraft could indeed penetrate Soviet airspace if it were required to do so, and provide valuable data for any subsequent bomber program.

Moreover, in addition to a fourth B-1A, funds were requested for the first two full production configuration B-1A bombers. On 22 February 1978, the Carter administration eliminated the funding ($500 million) needed to build the first two B-1A production aircraft, but authorized $442 million to manufacture a fourth B-1A test vehicle. The B-1A program had been granted a limited, and temporary, reprieve.

The cancellation of the B-1 production program was a serious blow to the aerospace community across the nation, and especially in Southern California. Many workers lost their jobs at a time when the overall economy was not able to fully absorb them. President Carter was seeking re-election, and the B-1 cancellation was not a popular decision in California. Carter attempted to ease the pain by partially raising the veil of secrecy surrounding the Advanced Technology Bomber (ATB) which would become the Northrop B-2 Spirit "stealth" bomber. In the meantime,



After the B-1A flight test program ended on 30 April 1981, all four aircraft were stored in the B-1 CTF hanger to await whatever was to happen. These four aircraft accumulated a total of 1,895.2 hours flying time during the B-1A flight test program. Two of them (number two and four) went on to participate in the B-1B flight test program. B-1A-2 (foreground) and B 1A-1 are on the right. On the left are B-1A-4 (directly across from B-1A-2) and B-1A-3. (Boeing North American)

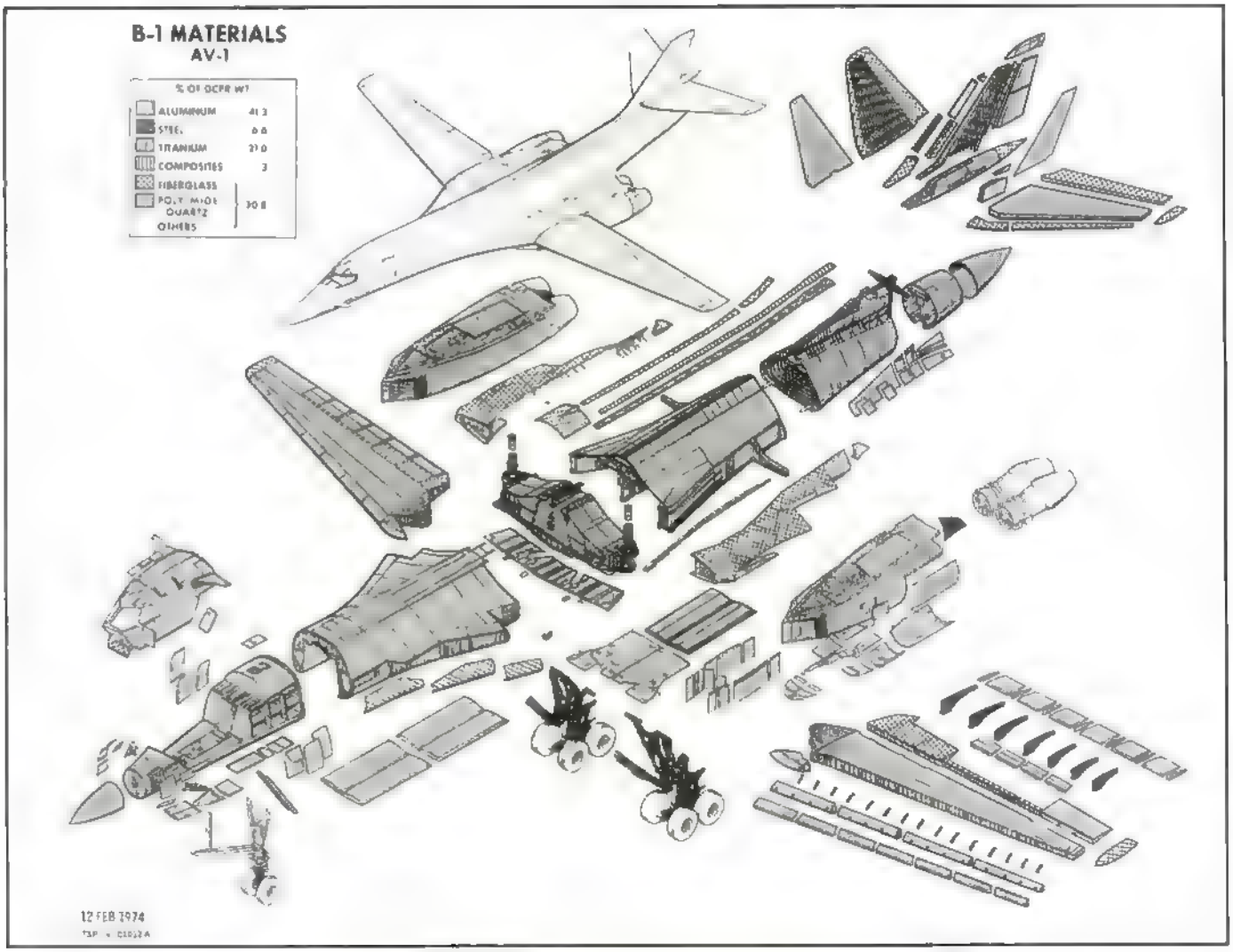


If the B-1A had entered into production, this illustration shows that the B-1A major subassemblies would have come from Rockwell's Palmdale and Los Angeles, California, facilities; Martin-Marietta's Baltimore, Maryland, plant; and the Brunswick Corporation's Marion, West Virginia, factory. Like the B-1B, the B-1A's final assembly location was to be in Palmdale. (Boeing North American)

presidential candidate Ronald Reagan, a champion for California's aerospace workers and a strong defense for America, continued to gain strength and was eventually elected as President. At the time he took office, no one had any idea that the B-1A program would eventually be resurrected as the B-1B program.

Strategic Triad Philosophy

America's strategic Triad philosophy uses manned bombers to complement ground-launched ICBMs and submarine-launched SLBMs. Throughout the 1970s, Soviet air defense and first strike capabilities both increased dramatically. Realizing the danger associated with Russia's much improved combat abilities, it became quite apparent that neither the mainstay B-52G/H nor the interim FB-111A could continue to be counted upon as first-strike weapons. The large (more than 488,000 pounds) and relatively slow (595 mph at high altitude) B-52G/Hs were very observable on radar. In fact, they have been likened to "flying barns," and their radar cross section (RCS) signatures approach 100 times that of the current B-1B The FB-111A on the other hand, while equipped with the most current low altitude penetration technology at the time, was really too small (about 110,000 pound) to possess the range and payload required to reach strategic targets within Russia. These deficiencies grew more striking as time moved into the 1980s. And since they could not be addressed by the



Some eight months before B-1A number one (AV/1 or Air Vehicle/One) rolled out, Rockwell released this graphic, which illustrated B-1A construction materials, to the public. The B-1A would be made up of 41.3% aluminum alloys, 30.8% combined fiberglass, polyimide quartz, and other materials, 21% titanium alloys, 6.6% steel alloys, and 0.3% composite-type materials. (Boeing North American)

canceled B-1A either, something new had to be developed.

On 30 April 1981, some three months after President Reagan took office, AV/4 made the last flight of the B-1A program. The four B-1As had been flying since December 1974 (AV/1); March 1976 (AV/3); June 1976 (AV/2); and February 1979 (AV/4), respectively. During more than six years of extensive testing the four B-1A development aircraft accumulated 1,895.2 flight hours. Without adequate funding to continue flight testing, they had been forced into extended storage within a hanger at Edwards AFB, where they awaited their final disposition to museums, scrap yards, or wherever.

Mission Impossible: Funding the ATB and LRCA

During 1978 President Carter authorized the Air Force to develop an Advanced Technology Bomber (ATB) to replace the recently cancelled B-1A and aging B-52G/H. The new bomber was to use radical new technology to render it nearly invisible to most radar. This "low observable" technology had first been used to its fullest on the Lockheed F-117A Nighthawk, although many of the basic concepts could trace their roots as far back as the U-2 and A-12/SR-71 programs.

The development program was a daunting task, and the four major aerospace contractors decided to establish two teams in order to bring sufficient resources to bear on

After President Reagan resuscitated the B-1 production program in the form of a fleet of 100 B-1Bs, two B-1As (numbers two and four) were modified to serve as B-1B test aircraft. The first B-1B test aircraft, formerly B-1A number two, is shown here during its first flight as such on 23 March 1983. Before it crashed on 29 August 1984 it was repainted with a B-1B style camouflage scheme. (Boeing North American)

the challenge. The Northrop/Boeing team, under code name Senior Ice, came up with an flying-wing design that had no vertical or horizontal stabilizers, and was powered by four non-afterburning turbofan engines. The Lockheed/Rockwell team, under code name Senior Peg, offered a scaled-up version of Lockheed's Senior Trend F-117A that was about the size of a B-58 Hustler and also used four non-afterburning turbofan engines. The existence of the new bomber was not officially announced to the public until 10 November 1988, just 12 days before the first B-2A made its public debut.

Each team had taken a very different course of action. Northrop/Boeing chose to design its ATB with subtle compound curves that were made possible because of significant advances in computational power, both during design and during flight. The Lockheed/Rockwell team stayed with the angular multi-faceted design pioneered by the Have Blue/F-117 because the technology had been demonstrated to work.

On 20 October 1981 the Northrop/Boeing team was announced as the winner of the ATB competition. It would build as many as 132 production aircraft, with the initial operational capability (IOC) scheduled for 1987. Clearly this was too long to wait for a B-52 replacement. The Air Force asked Rockwell and General Dynamics to submit proposals for modified versions of existing aircraft, specifically the B-1A and FB-111A, to supplement the new B-2A. Because they were to based on existing designs, they were supposed to be available quickly.

On 1 June 1981, the Air Force issued a report to President Reagan, Defense Secretary Caspar Weinberger, and Congress stating why it preferred Rockwell's proposed Long Range Combat Aircraft (LRCA) version of the B-1A over the alternative General Dynamics FB-111H, a stretched and reengined version of the FB-111A.

During the next three-plus months, President Reagan, Secretary Weinberger, and Congress considered the options. On 2 October 1981 President Reagan, who in part had run on a stronger defense for America platform to help him win the presidency, announced that Rockwell would build 100 new B-1Bs. On 20 January 1982 the Air Force awarded two contracts totaling $2.2 billion, one to initiate B-1B testing using two modified B-1As, and the second for a single B-1B to initiate the production program.

With two new strategic bomber aircraft programs underway instead of none a few weeks earlier, the expected question came up: "Where's all this funding coming from?" It was both a logical and hard question to answer. At the time America, as a nation, was in a reces-

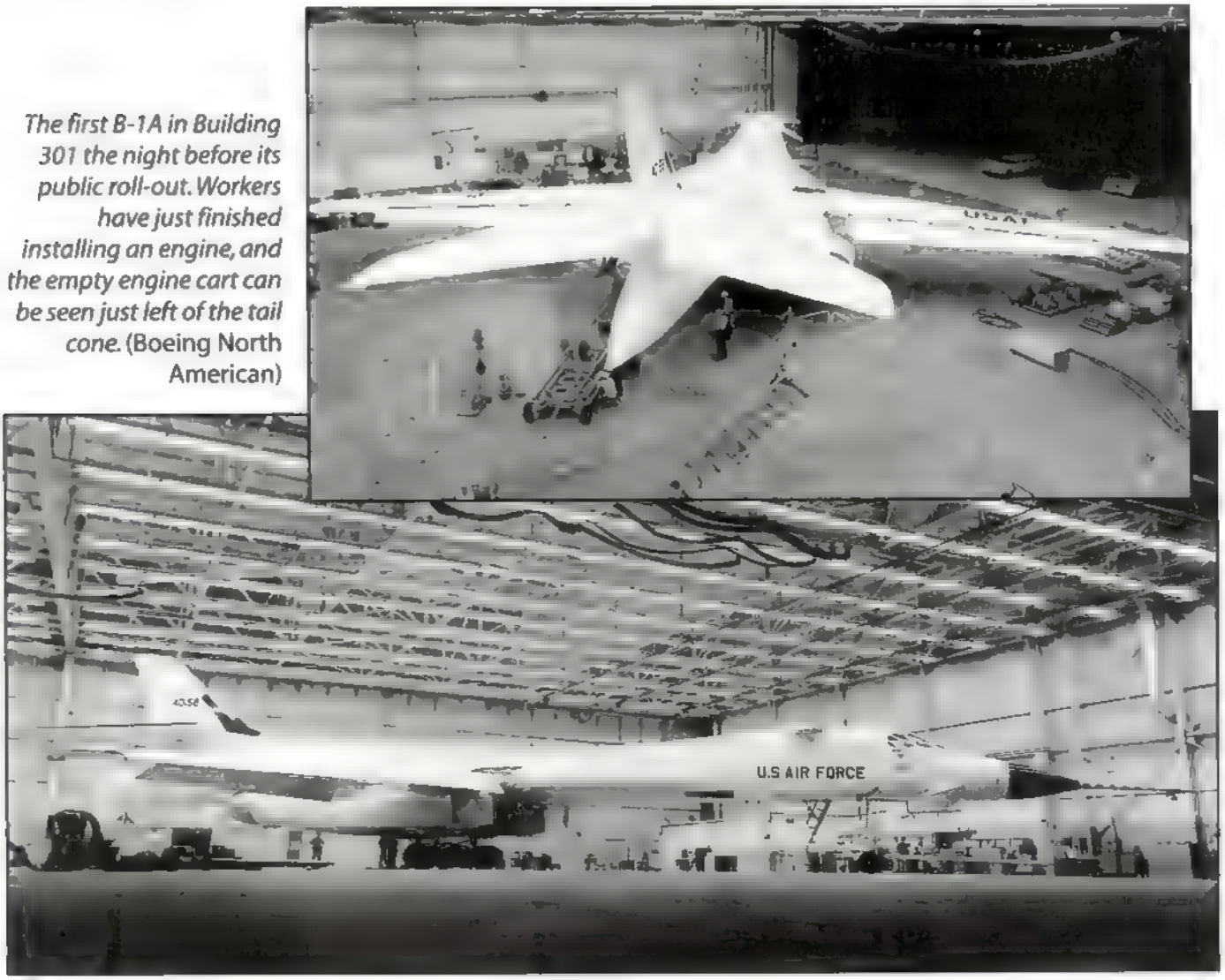
sion and unemployment was at the highest level since the Great Depression. Still, Reagan's defense spending continued to increase unabated. It would be another decade before some sense of reality was injected into the spending spree.

B-1B Test Program

The B-1B test program began on 23 March 1983 when the number two B-1A (74-0159) made its first flight at Edwards AFB after being configured with B-1B flight controls and other modifications. The number fourth B-1A (76-0174), modified to evaluate the B-1B's intended defensive and offensive systems, joined the B-1B test program a little later.

Unfortunately, on 29 August 1984, 74-0159 crashed near Edwards AFB while on a low-level test flight. Tragically, although its four-place emergency escape capsule successfully jettisoned before the aircraft impacted the ground, the capsule's ventrally mounted impact bladder did not work well enough to adequately cushion what turned out to be a very hard landing. Rockwell test pilot Doug Benefield was killed and the two other crew members suffered serious injuries. The remaining B-1B test aircraft (76-0174) continued flying until 31 October 1985, when it made the last flight of the B-1B test program.

From September 1984 through January 1988 Rockwell produced 100 B-1Bs for a total cost of less than $20.5 billion. But at a cost of about $2 billion per copy, America simply could not afford to buy 132 B-2A aircraft. Instead, at this writing, only 21 B-2 aircraft have been built.



The first B-1A in Building 301 the night before its public roll-out. Workers have just finished installing an engine, and the empty engine cart can be seen just left of the tail cone. (Boeing North American)

The raised stabilizing fins on the crew ejection capsule (just above the word "AIR") are noteworthy, as is the long nose boom equipped with alpha and beta vanes. (Boeing North American)

On 23 December 1974 the first B-1A took off from Palmdale on its maiden flight. One hour and 18 minutes later, after a very successful test flight, she landed at Edwards AFB. It was also the first flight for the first four flight rated YF101 turbofan engines. (Boeing North American)

Shown here on the Palmdale ramp just a few days after its public debut, the first B-1A underwent systems checkout and servicing (hydraulic fluid, fuel, oil, and so on) and an extensive series of pre-flight tests before she could be cleared for her first flight. (Boeing North American)

The first B-1A was rolled out of Building 301 in Palmdale on 26 October 1974. (Boeing North American)

B-1B Building Blocks

Structures and Systems

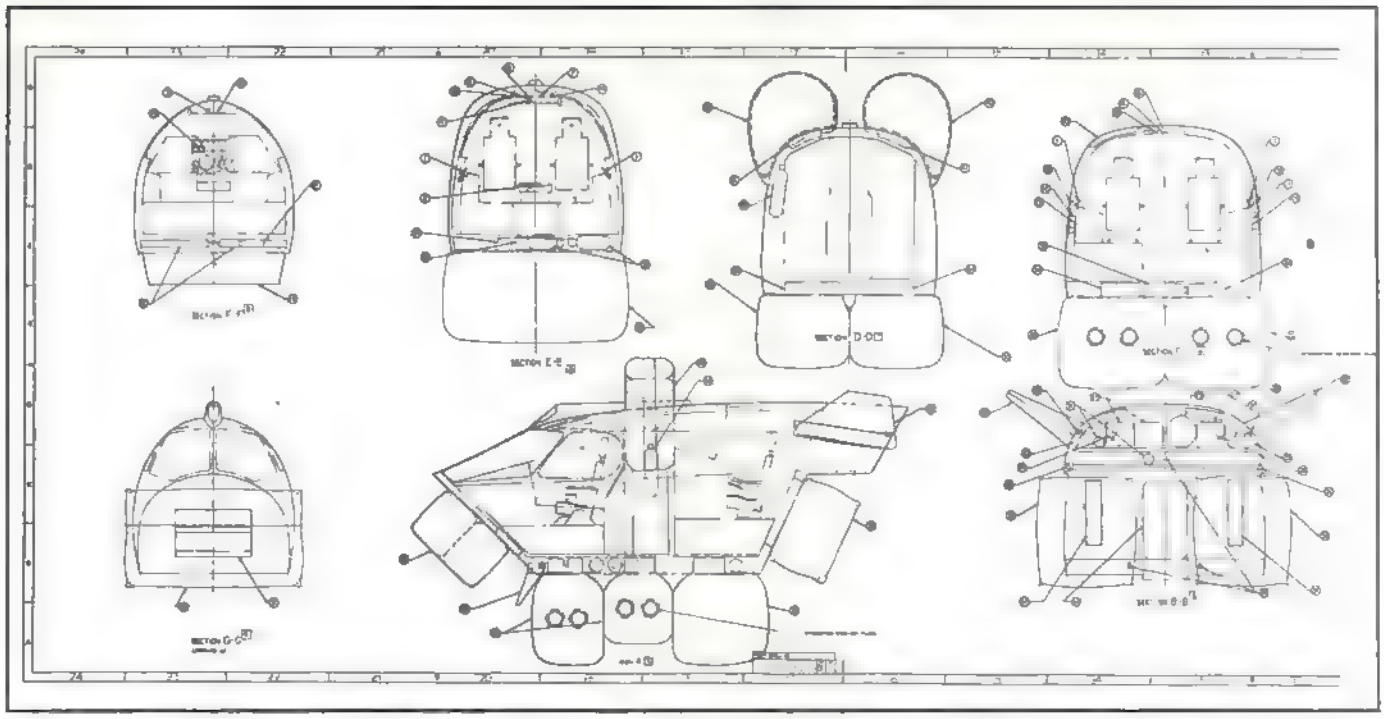
Typical of most modern weapons systems, the B-1B is an extremely complex machine. Although much of the B-1 has proven to be extremely reliable, some systems, particularly the defensive avionics, have given their developers more than their share of problems. Highlights of the major systems are discussed below.

Fuselage Structure

The B-1B fuselage is constructed primarily of conventional aluminum alloy arranged in a skin-frame-longeron type of semi-monocoque. Titanium is used in the wing carry-through structure, engine nacelles, and tail support structure, where high load concentrations exist. Titanium alloy is also used for the aft fuselage skins where high temperatures and acoustic levels are prevalent. Dielectric materials such as polyimide quartz and fiberglass are used for radomes and antenna covers. The Lancer's fuselage was manufactured in six major sections, then mated together prior to attaching wings, empennage (tail group), landing gear, and engine nacelles.

The crew station houses a crew of four: pilot, copilot, defensive systems operator, and offensive systems operator. Each crew member rides on an Advanced Concept Ejection Seat (ACES II) developed by McDonnell Douglas (now Boeing) and built by Weber Aircraft. The structural elements include a sealed crew compartment pressurized for an 8,000-foot altitude environment; a clear vision windscreen designed to stringent bird proof requirements; and an entry door and emergency escape hatch for crew ingress and egress.

The first take-off of B-1A number two (74-0159) as B-1B flight test aircraft number one occurred at Edwards AFB on 23 March 1983. It flew for another 17 months before crashing on 20 August 1984. (Boeing North American)



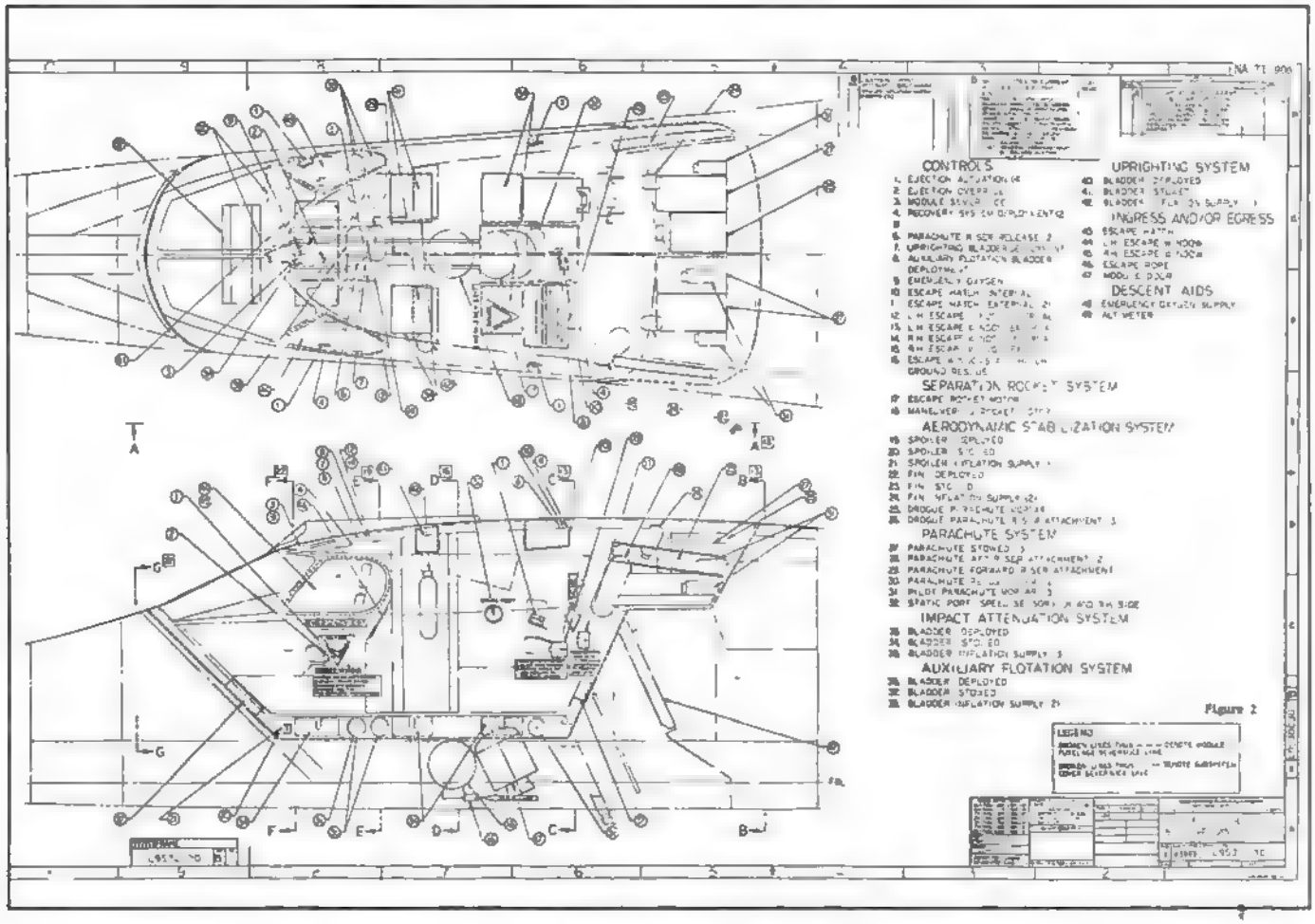
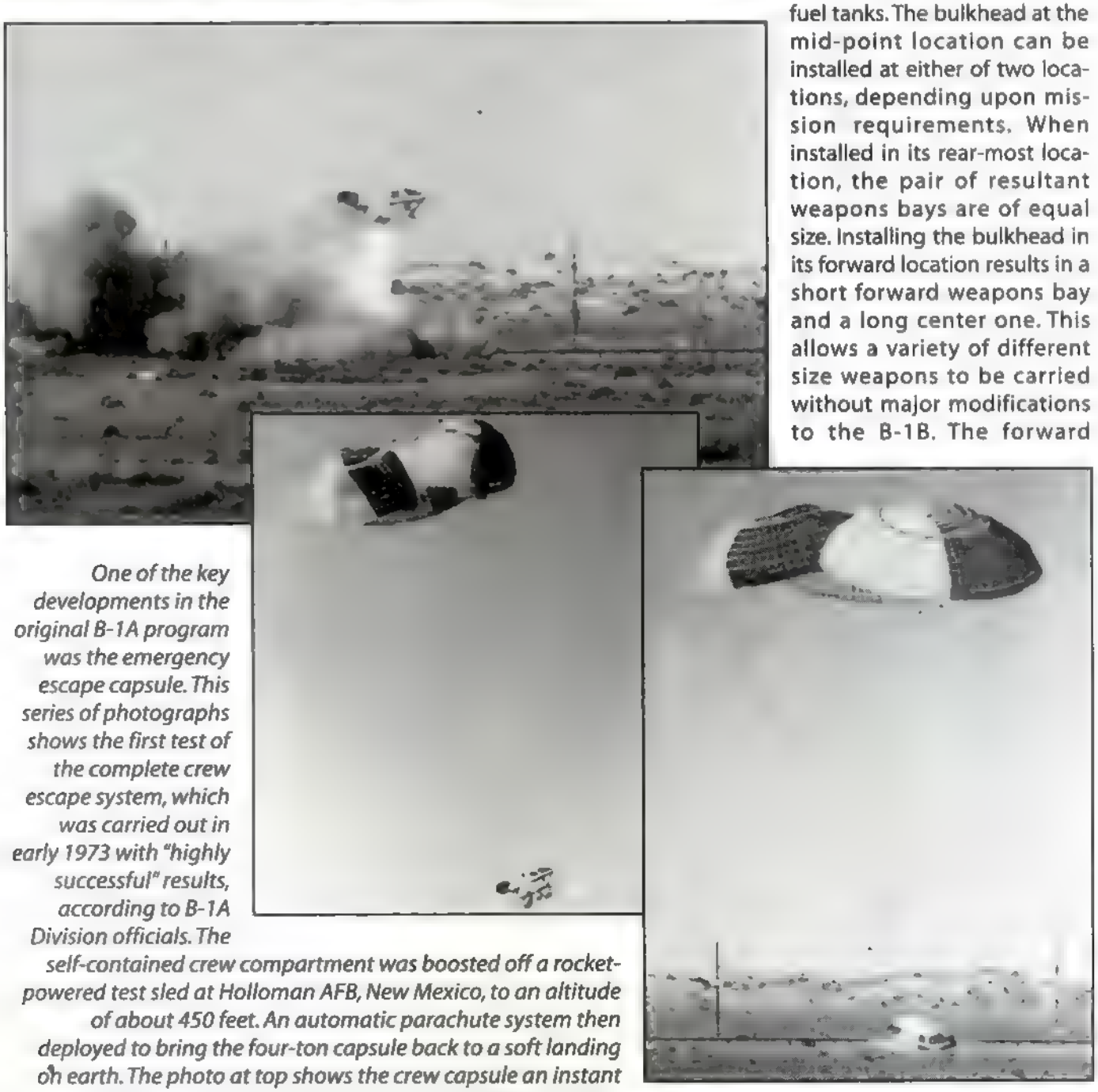


Diagram of the original four-man ejection capsule used on the first three B-1As. The top illustration shows the configuration of the inflated impact-absorbing bags under the capsule. (Boeing North American)

The lower forward fuselage section includes the nose radome; a forward avionics bay; the in-flight refueling receptacle; the nose landing gear well, doors and support structure; crew entry stair ladder; central avionics bay; forward fuel tank; and environmental control equipment bay. In addition to other avionics gear such as antennas, surveillance cameras, pressure and temperature sensing equipment, and the structural mode control system fins are also found on the lower forward fuselage section.

The forward intermediate fuselage section includes the forward and center weapons bays. Bulkheads at the front of the forward bay, at the mid-point location between the bays, and at the aft end of the center bay support the rotary weapons launchers, bomb racks, or auxiliary fuel tanks. The bulkhead at the mid-point location can be installed at either of two locations, depending upon mission requirements. When installed in its rear-most location, the pair of resultant weapons bays are of equal size. Installing the bulkhead in its forward location results in a short forward weapons bay and a long center one. This allows a variety of different size weapons to be carried without major modifications to the B-1B. The forward



One of the key developments in the original B-1A program was the emergency escape capsule. This series of photographs shows the first test of the complete crew escape system, which was carried out in early 1973 with "highly successful" results, according to B-1A Division officials. The self-contained crew compartment was boosted off a rocket-powered test sled at Holloman AFB, New Mexico, to an altitude of about 450 feet. An automatic parachute system then deployed to bring the four-ton capsule back to a soft landing on earth. The photo at top shows the crew capsule an instant after separation from a B-1A forward fuselage mockup mounted on a sled moving down a test track at 90 mph. The middle shows how the three main Apollo-like parachutes are deployed and shock absorber attenuator bags under the capsule are inflated. In the bottom photo, the capsule is shown at the instant of touch down near the test track. (Boeing North American)

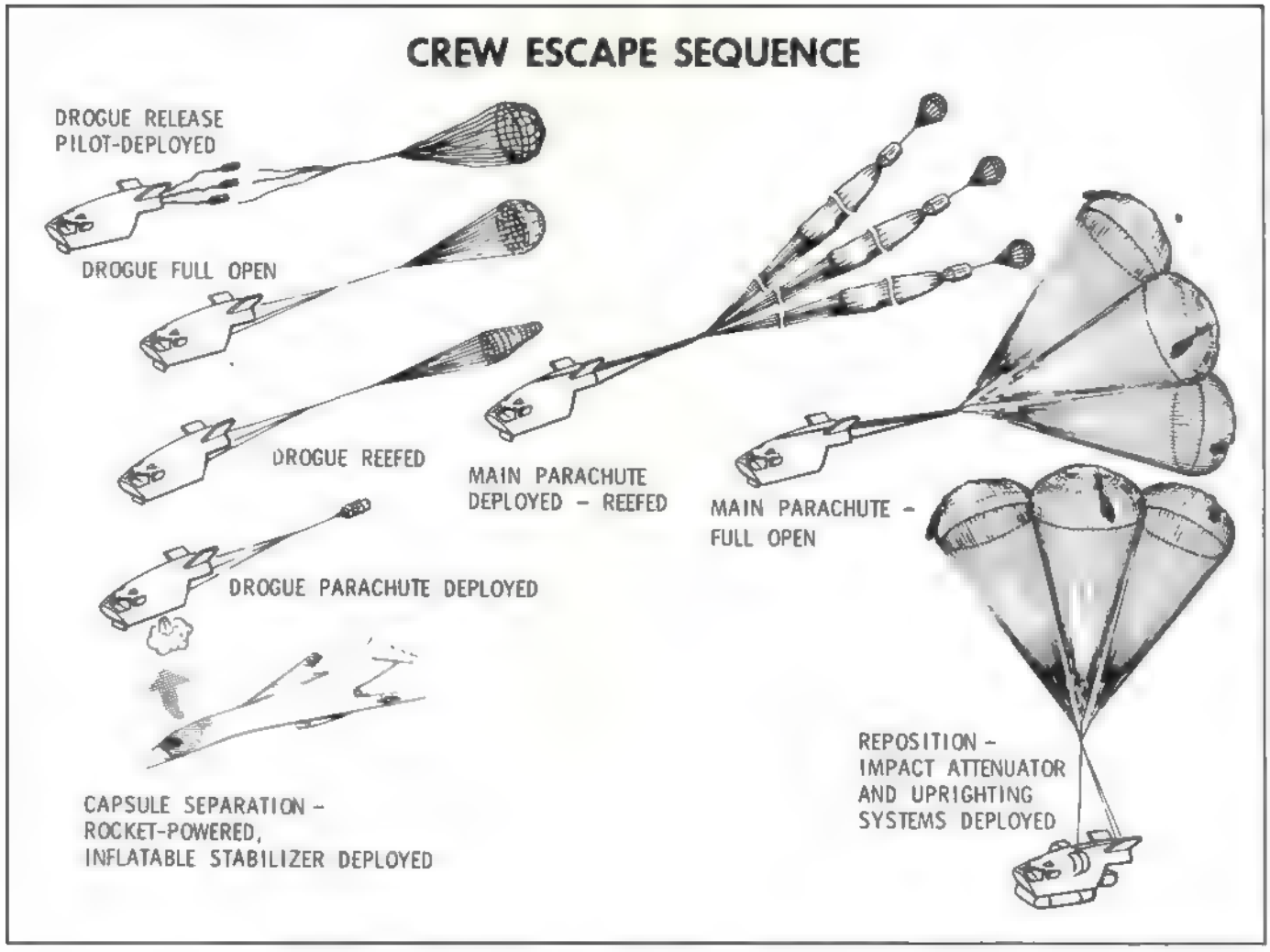


Diagram of the escape sequence used by the crew escape capsules used on the first three B-1As. Each primary B-1A crew member was provided with an individual loop-type ejection handle to initiate an ejection. Unfortunately, when B-1A-2 crashed from relatively low altitude during the B-1B flight test program, the crew escape capsule safely departed the aircraft but the main parachutes did not have enough time to open fully. The capsule's impact with the ground was too severe, and Doug Benefield suffered fatal injuries. Fortunately, the other two crew members survived. (Boeing North American)

weapons bay doors are segmented to allow them to open differently, depending upon the configuration of the bays. The aft bulkhead is part of the wing carry-through section.

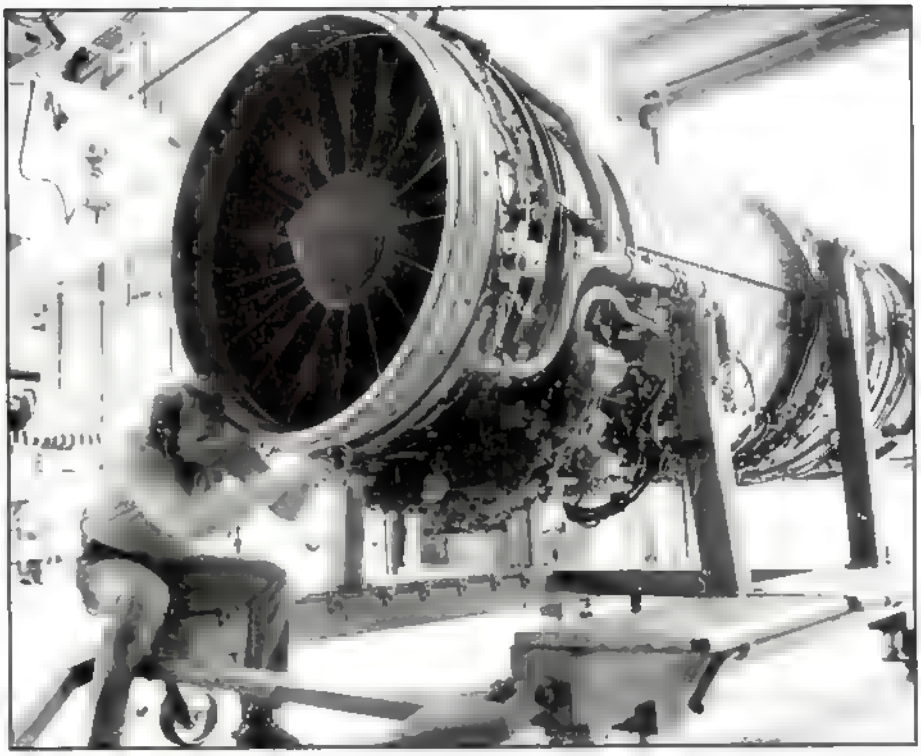
Large integral fuel tanks are incorporated into the structure immediately outboard of the weapons bays. A systems routing tunnel occupies the upper section between the longerons. Provisions for avionics equipment and antennas are incorporated in the side fairing areas.

The aft intermediate fuselage section consists of the main landing gear wells, doors and support structure; and the aft weapons bay. It incorporates an integral fuel tank above the main landing gear wells and avionics provisions between wheel wells. Bulkheads at the forward and aft ends of the weapons bay support the rotary weapons launcher. As in the forward intermediate fuselage section, fuel is stored outboard of the weapons bay.

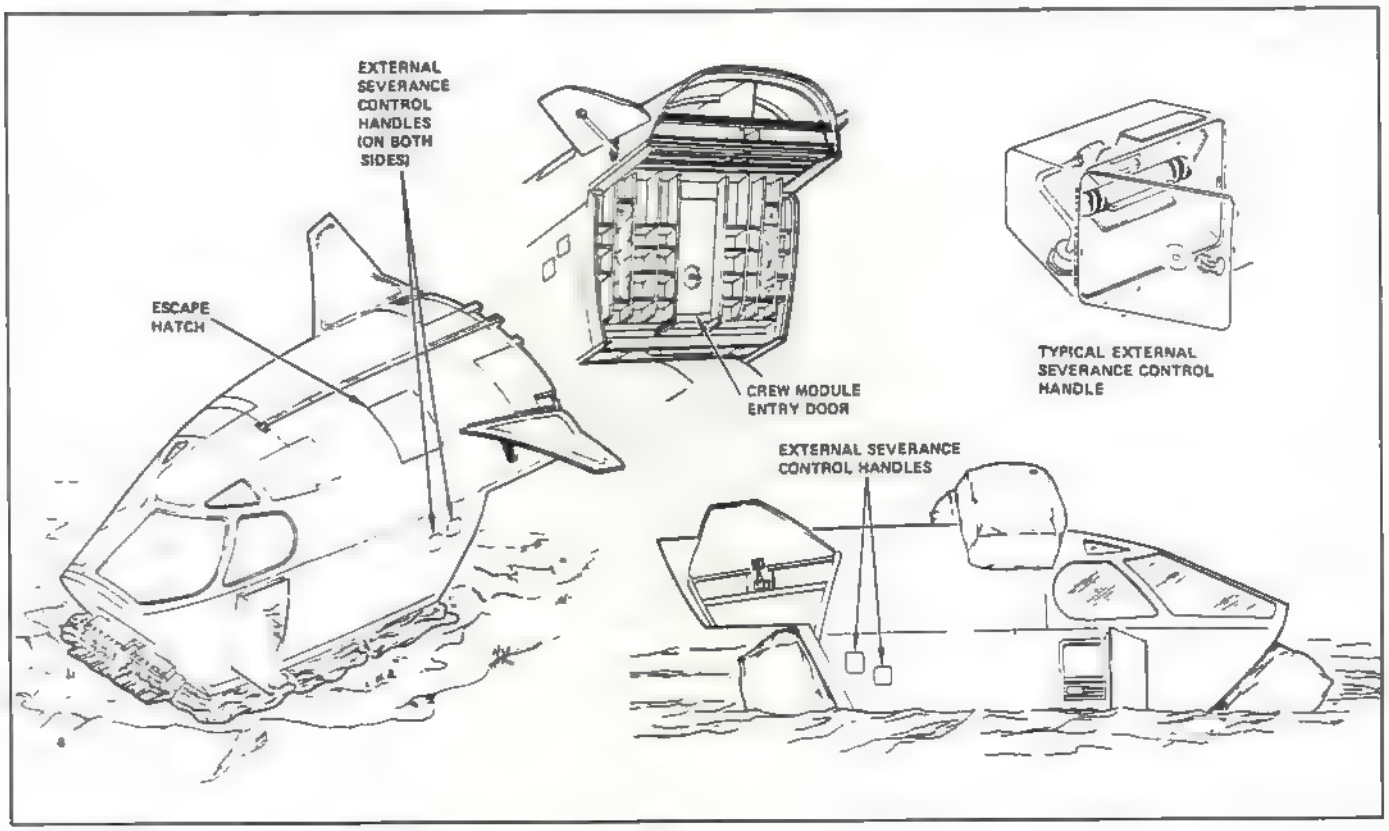
The aft fuselage section is constructed of titanium skins and outer frame caps for temperature resistance and supports the vertical and horizontal stabilizers The horizontal stabilizer is all-flying—a feature more usually found on fighter aircraft. The horizontal stabilizer spindle fitting is made of steel and is attached directly to the titanium aft fuel tank bulkhead. An aft avionics bay is located aft of the fuel bulkhead, as is the aft-looking radar and its radome.

Flight Control System

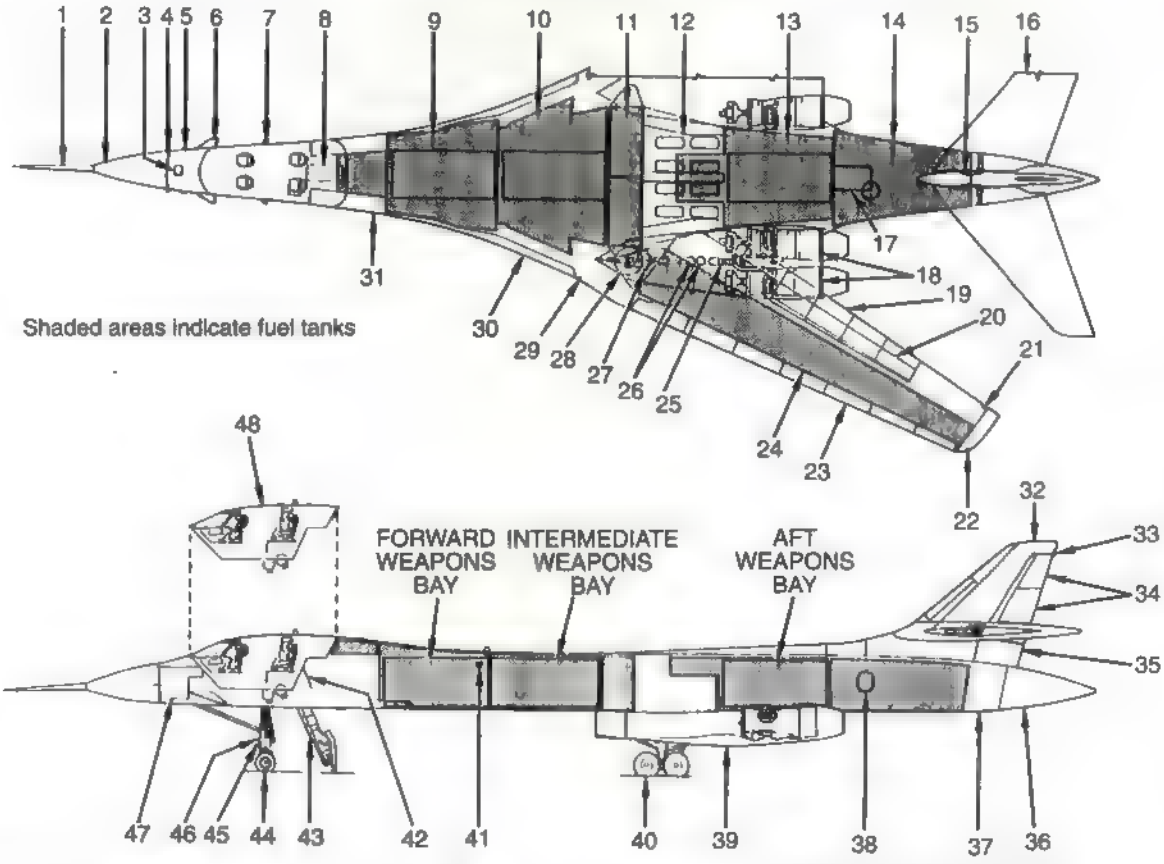
Manual control of the primary flight control surfaces (horizontal stabilizers, rudder and spoilers) is redundant with both electrical and hydraulic actuators. Electrical control of the horizontal stabilizer and rudder is through a fail-operational, fail-safe Stability and Control Augmentation System (SCAS). An automatic flight control system provides pilot assistance through an interface with the SCAS. Electrical control of the spoilers is pro-



General Electric's F101-GE-102 augmented turbofan for the B-1B has a low-pressure system consisting of a fan and a two-stage uncooled turbine. The fan has variable inlet guide vanes and produces a pressure ratio of about two. The high-pressure system, or core engine, consists of a nine-stage axial flow compressor with variable stators, an annular-type combustor with an atomizing fuel-injector system, and a single-stage, air-cooled turbine. (General Electric)

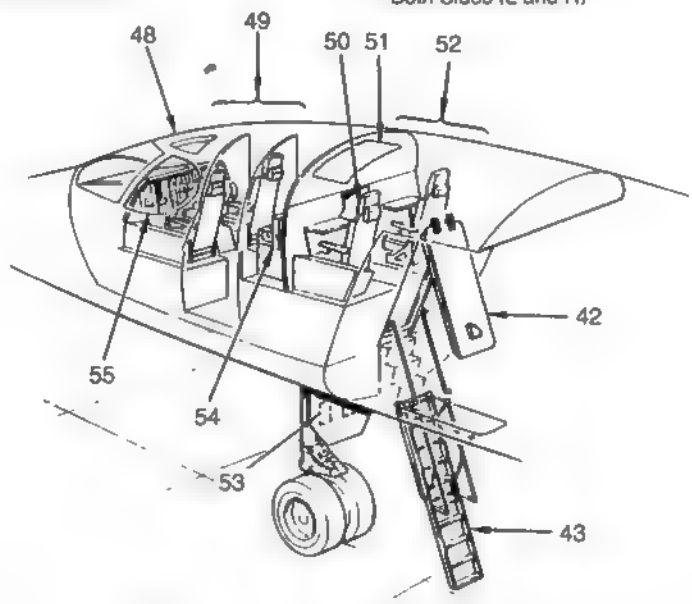


B-1A crew escape capsule floatation devices. (Boeing North American)

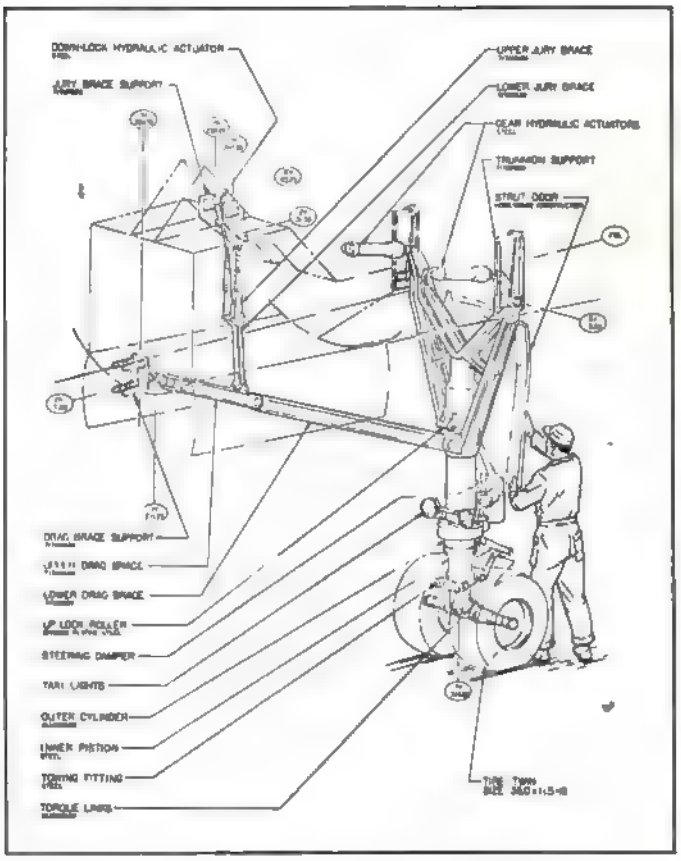


1 PITOT STATIC BOOM (WITH AOA AND SIDESLIP VANES)
2 FORWARD RADOME
3 AERIAL REFUEL RECEPTACLE
4 PITOT STATIC PROBE *
5 TOTAL TEMPERATURE PROBE *
6 STRUCTURAL MODE CONTROL SYSTEM VANE *
7 ANGLE OF ATTACK VANE *
8 CREW ENTRY WAY
9 FORWARD FUSELAGE FUEL TANK (TANK NO 1)
10 FORWARD INTERMEDIATE FUSELAGE FUEL TANK (TANK NO 2)
11 MAIN FUEL TANKS
12 MAIN GEAR BAY EQUIPMENT COMPARTMENT
13 AFT INTERMEDIATE FUSELAGE FUEL TANK (TANK NO 3)
14 AFT FUSELAGE FUEL TANK (TANK NO 4)
15 HORIZONTAL STABILIZER ACTUATOR *
16 HORIZONTAL STABILIZER
17 FLIGHT CONTROLS MIXER BAY
18 ENGINES *
19 FLAPS (6) *
20 SPOILERS/SPEED BRAKES (4) *
21 FUEL JETTISON OUTLET *
22 POSITION LIGHT *
23 SLATS (7) *
24 WING FUEL TANK *
25 APU *
26 HYDRAULIC RESERVOIRS *
27 INLET RAMP MECHANISM *
28 WING PIVOT
29 ALTERNATE POSITION AND ANTICOLLISION LIGHT *
30 WING GLOVE AVIONICS COMPARTMENT *
31 CENTRAL AVIONICS COMPARTMENT *
32 VERTICAL STABILIZER
33 TAIL/ANTICOLLISION LIGHT
34 UPPER AND INTERMEDIATE RUDDERS
35 LOWER RUDDER
36 AFT RADOME
37 AFT AVIONICS COMPARTMENT
38 LN_2 DEWAR
39 ENGINE NACELLE *
40 MAIN LANDING GEAR *
41 AERIAL REFUEL/WING INSPECTION LIGHT *
42 ENTRY DOOR
43 ENTRY LADDER
44 NOSE LANDING GEAR
45 LANDING/TAXI LIGHT
46 LANDING LIGHTS (2)
47 FORWARD AVIONICS COMPARTMENT
48 EJECTABLE CREW MODULE
49 FORWARD CREW STATIONS
50 CREW SEAT (4)
51 ESCAPE HATCH (SEVERABLE)
52 AFT CREW STATIONS
53 CONTROLS FOR ENTRY LADDER, APU, AND MAIN GEAR DOORS
54 SURVIVAL EQUIPMENT
55 SIDE WINDOW (SEVERABLE) *

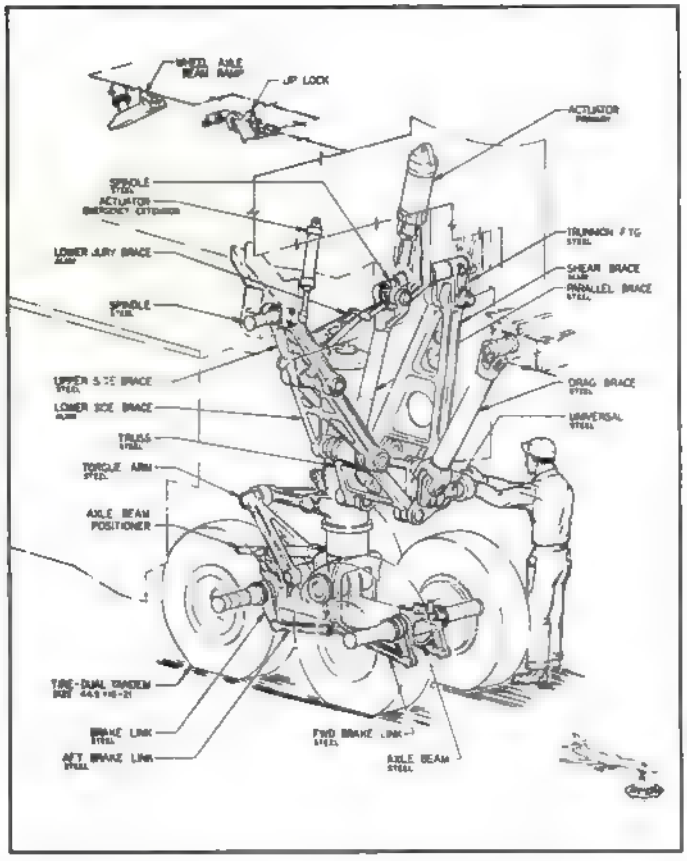
* Both Sides (L and R)



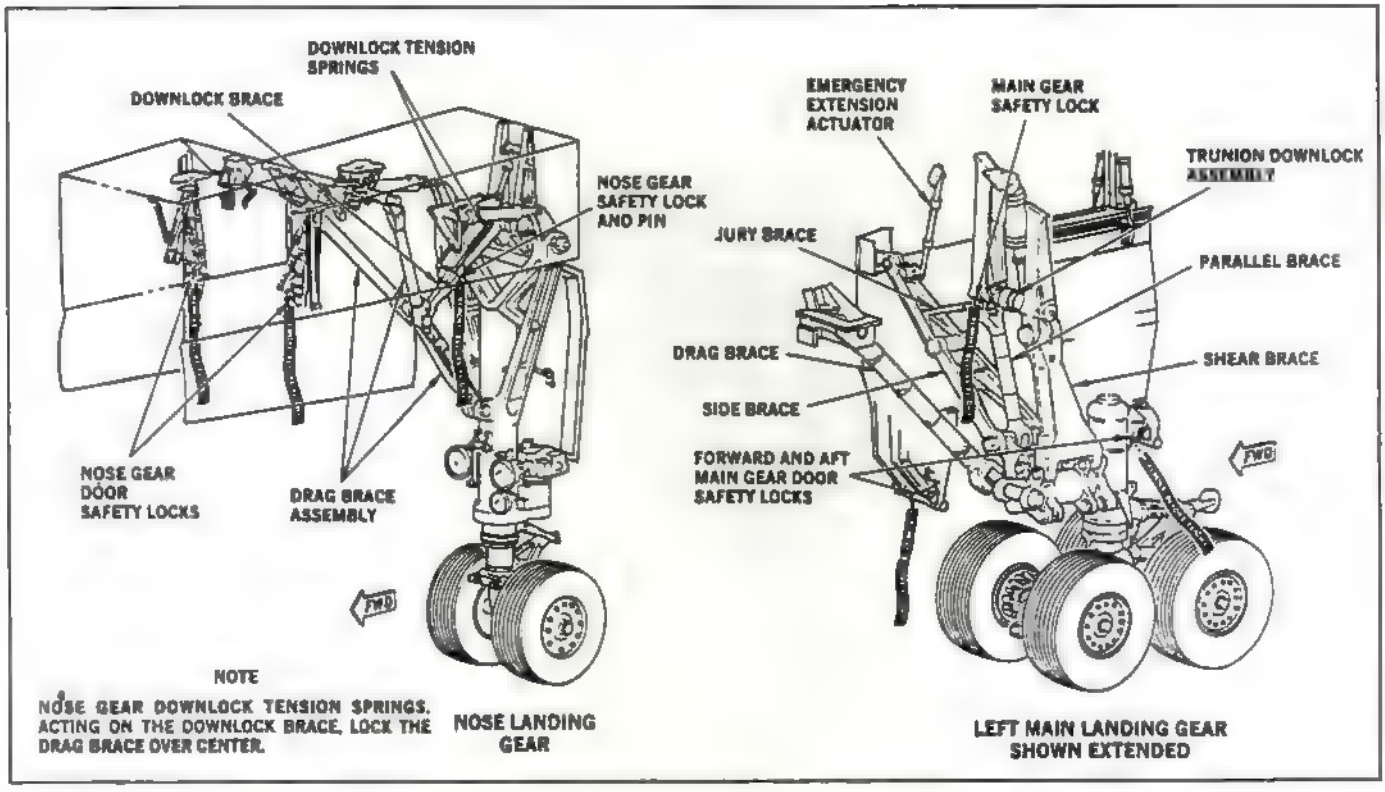
B-1A major component locations. (Boeing North American)



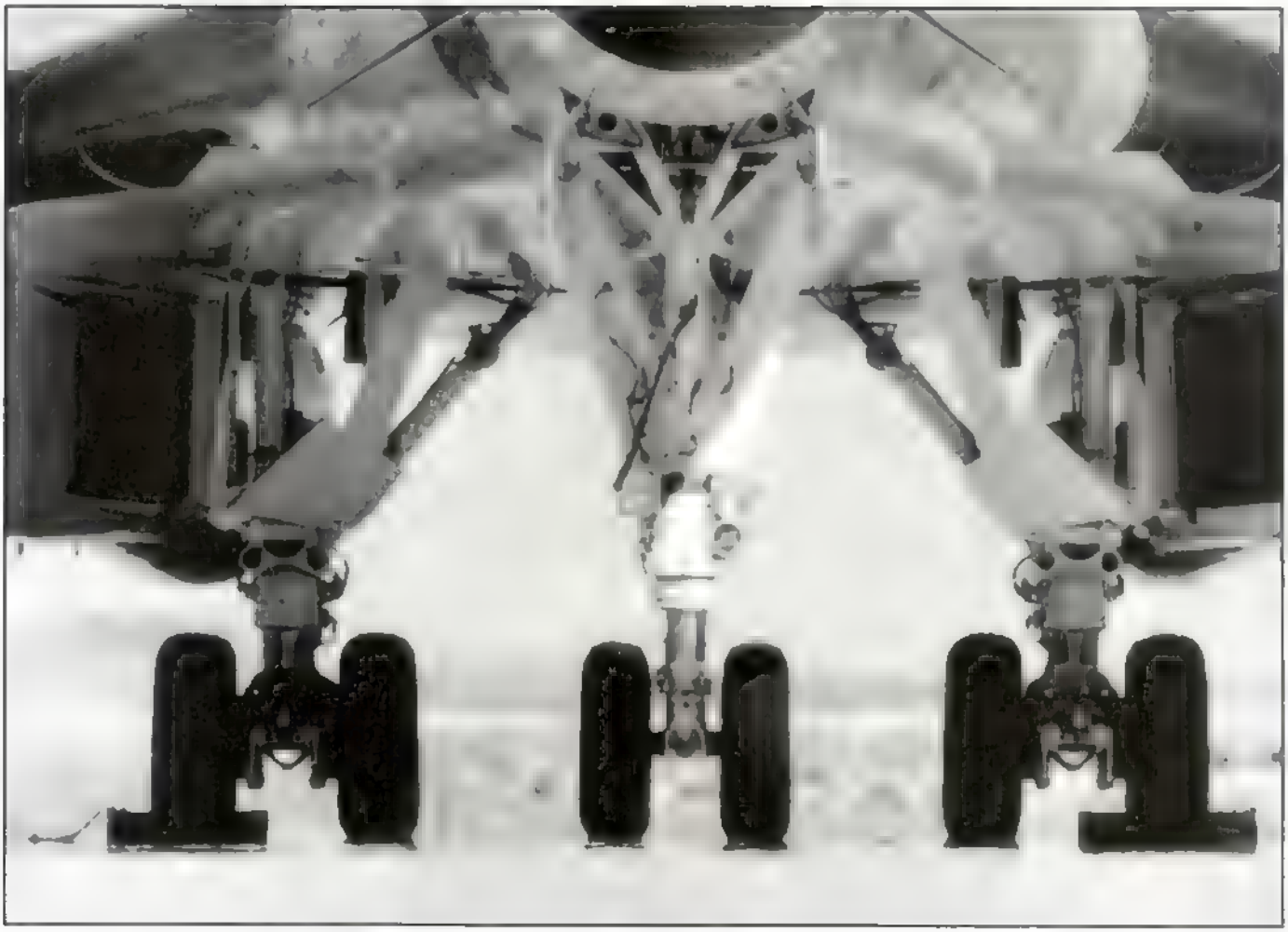
B-1A nose landing gear. (Boeing North American)



B-1A main landing gear. (Boeing North American)



B-1B nose and main landing gear (compare with the original B-1A units, above). (Boeing North American)



B-1A landing gear. (Boeing North American)

vided by a fail-operational, fail-safe position system. The horizontal tails and rudders are powered by four hydraulic systems while the spoilers are powered by three.

Primary pitch (nose-up/down) and roll (wingtips-up/down) trim control is provided by the SCAS. Standby pitch and roll trim is provided by electromechanical actuators. A trim-for-takeoff system assures that the flying control surfaces are in the proper configuration for takeoff.

Manual control of the flaps and slats is provided by a fail-operational, fail-safe electrical system which also provides asymmetric monitoring. The flaps are powered by two hydraulic systems. Manual control of the wing sweep position is provided by a mechanical system powered by four hydraulic systems. Standby wing forward-only control is provided by an auxiliary electromechanical system. Each wing has seven leading-edge slat panels, four spoiler panels, and six trailing-edge flap panels. The flaps and slats are powered by two hydraulic systems while the spoilers use three.

The variable geometry or "swing" wing of the B-1B travels from 15° (136 feet, 8.5 inches) fully forward to 67.5° (78 feet, 2.5 inches) fully swept aft. The wings are automatically swept aft during high speed flight to decrease drag forces and structural loads, and swept forward to provide increased wing lift for takeoffs and landings. The flap interlock system prevents sweeping the wings with the flaps extended and also prevents accidental actuation of the flaps when the leading edge of the wing is not located between the 15 to 20° position.

The upper, intermediate, and lower rudders provide yaw (nose-left/right) control and yaw trim. The lower rudder segment provides yaw dampening through the SCAS. The rudders are powered by four hydraulic systems.

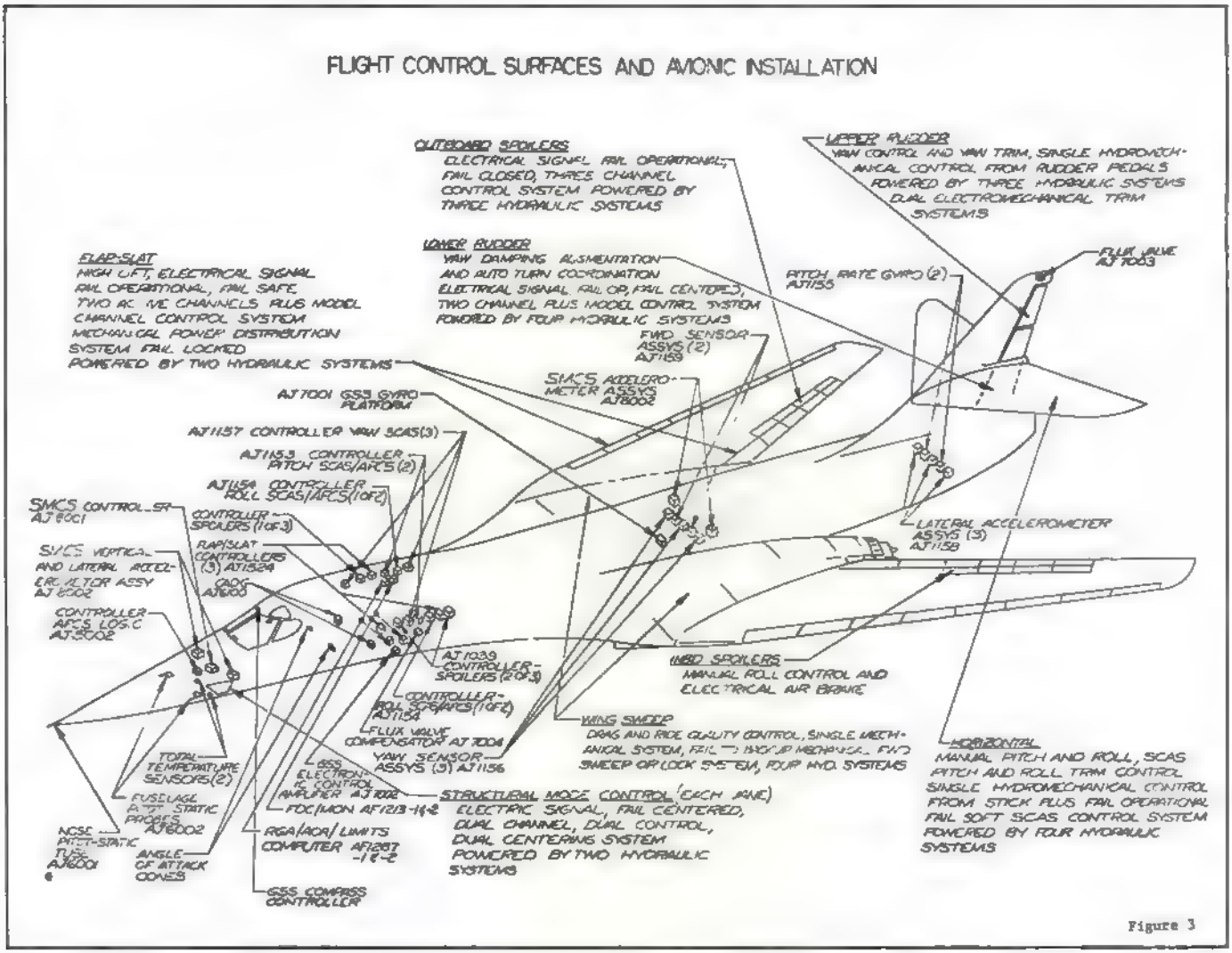
Main and Nose Landing Gear Subsystems

The main landing gear system consists of a dual compression ratio air-oil shock strut equipped with twin tandem wheels. Each wheel is 44.5 inches in diameter and uses 16.0-inch wide tires. Each main landing gear assembly weighs about 5,500 pounds. The main gear is retracted laterally inboard and aft into the fuselage by the combined action of the main gear hydraulic retraction actuator and the downlock hydraulic actuator. The main gear fully retracts in approximately 12 seconds. Provisions exist for emergency lowering of the doors and gears in the event of a hydraulic system failure.

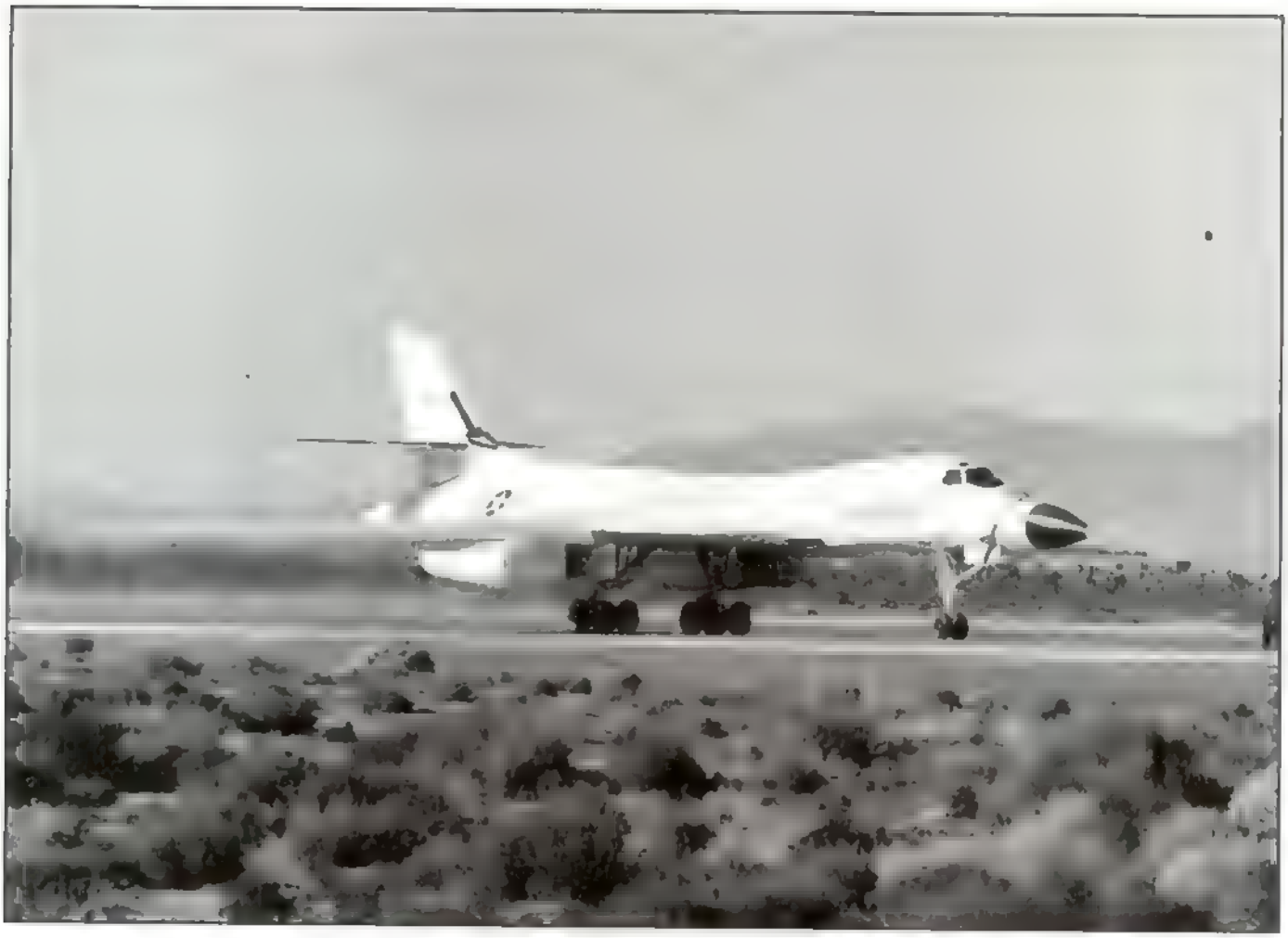
The nose landing gear system also consists of a dual compression ratio air-oil shock strut, but with a single set of side-by-side wheels. The wheels are 35 inches in diameter and use 11.5-inch wide BF Goodrich tires. Hydraulic power steering is incorporated and the wheels can be turned up to 75°, either side of center. The nose landing assembly weighs approximately 1,100 pounds. The nose gear is retracted forward and upward into the fuselage by two hydraulic actuators in about 12 seconds. Like the mains, the nose gear has provision for emergency lowering if required.

AN/ALQ-161A Defensive Avionics System

The B-1B's AN/ALQ-161A Defensive Avionics System (DAS) was developed by the AIL Division of Eaton Corporation, Deer Park, New York. The DAS enables the Lancer to accomplish a wide range of missions, including deep solo penetration of enemy air space. A number of additions to the original B-1A DAS have extended both the fre-



B-1A flight control surfaces and avionics installation. (Boeing North American)



The first B-1A during a high-speed taxi test at Palmdale on 18 December 1974—five days prior to its first flight. (Boeing North American)

quency coverage and the repertoire of electronic jamming techniques used by the B-1B.

The AN/ALQ-161A is a computer controlled radar warning and active countermeasures system designed to defeat all known threats. All system components plug into a dedicated data bus network, allowing flexibility to meet future threats.

The system is comprised of more than 100 line replaceable units (LRU), including receivers, transmitters, processors, and antennas. The AN/ALQ-161A, not counting wiring, weighs about 4,800 pounds and consumes 110 kilowatts of power in an all-out jamming mode. Most of the LRUs, of which some 52 are unique in design, are between 1 to 2 cubic feet in volume and weigh between 40 and 80 pounds.

AN/ASQ-184 Offensive Avionics System

The B-1B's AN/ASQ-184 Offensive Avionics System (OAS) is produced by the Boeing Military Airplane Company (BMAC) in Wichita, Kansas. This system allows the Lancer to navigate to its target and to align and launch its weapons. The OAS design includes the capability to readily accept future growth mission requirements, which includes precision-guided bombs and conventional standoff weapons, such as the AGM-86C Conventional Air-Launched Cruise Missile (CALCM).

The primary ASQ-184 enhancements over the B-1A include improved central computing capability, improved radar equipment, upgraded inertial navigation system and redesigned controls and displays. The ASQ-184 uses a Mil-Std-1553B data bus interface between the avionics hardware elements which greatly reduces the requirement for special adapters or interface units, and simplifies the addition of growth equipment.

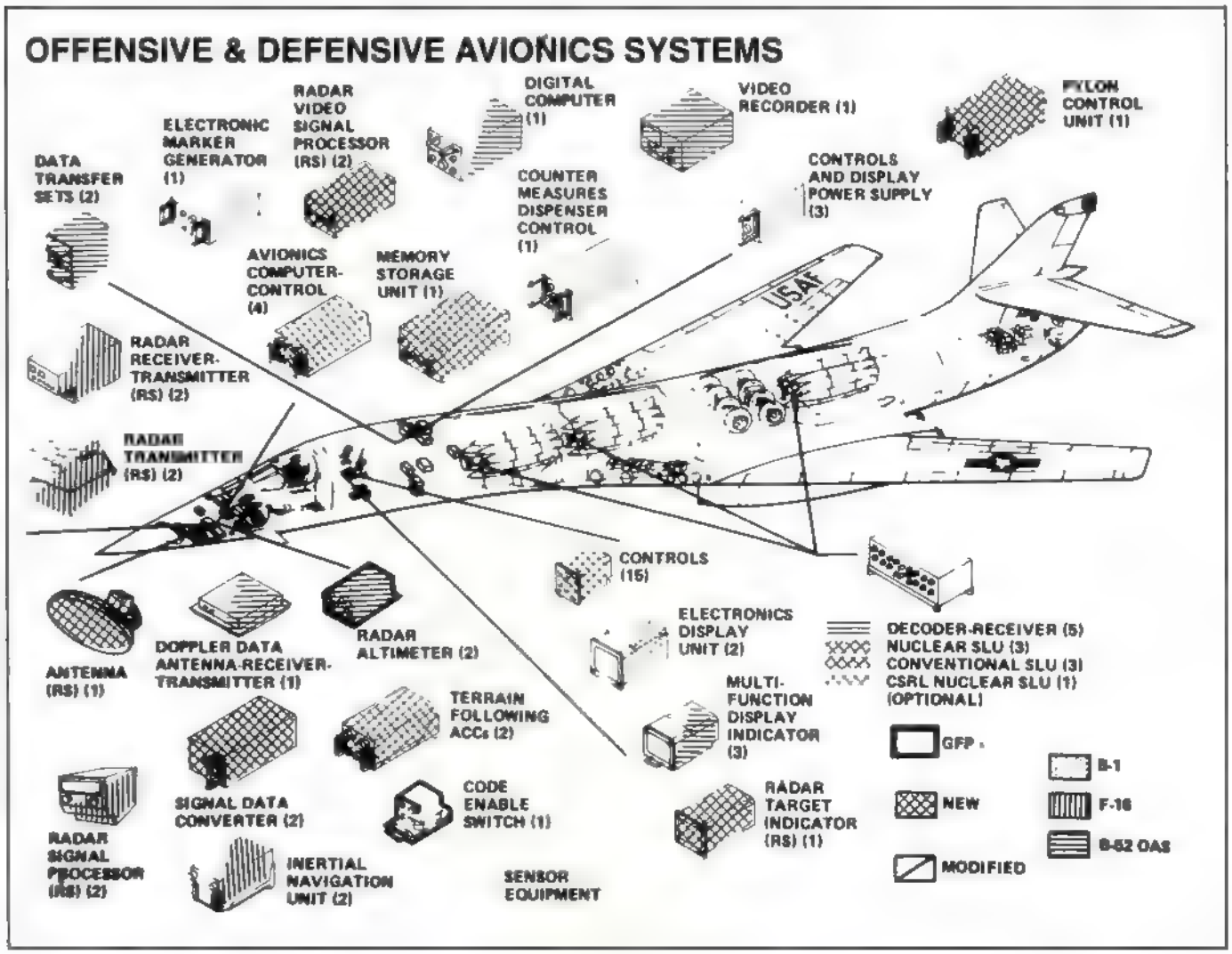
The B-1B's offensive radar is a multimode dual channel system developed by Westinghouse based on the proven APG-68 design used on the F-16C/D Fighting Falcon. Combined with BMAC's terrain following computers and radar data terminals, it replaces the separate forward looking and terrain following radars used on the earlier B-1A.

Stores management functions on the B-1B have been advanced over those of the B-1A by including the capability to deliver additional weapon types. In its development stage, the B-1A was limited to delivering nuclear bombs and AGM-69A SRAMs. The B-1B, on the other hand, has the capability of delivering conventional iron bombs, AGM-86 cruise missiles, and most other weapons in the US arsenal.

In mid-1995, Boeing initiated the multi-phase B-1B Conventional Mission Upgrade Program (CMUP) to enhance the Lancer's effectiveness as a conventional weapons carrier. As part of the CMUP, Boeing has developed software to integrate the Global Positioning System (GPS) and the Joint Direct Attack Munition (JDAM) into the AN/ASG-184 OAS. The CMUP enables the aircraft to carry and release multiple types of weapons on a single mission and also incorporates improvements to the Lancer's electronic ALQ-161A defensive avionics system.

Structural Mode Control System

To meet its high-speed (approximately Mach 0.90) and low-altitude (200-500 feet) penetration requirement, the B-1B is equipped with a unique structural mode control system (SMCS) which had originally been developed during the B-1A program. The SMCS detects and automatically dampens structural bending oscillations in the pitch



B-1A offensive and defensive avionics systems. (Boeing North American)

The B-1B assembly line at US Force Plant 42, Palmdale, California. (Boeing North American)

and yaw axes of the aircraft during low level penetration flights. And equally important, the B-1B's SMCS allows a stable weapon launch platform at such speeds and altitudes.

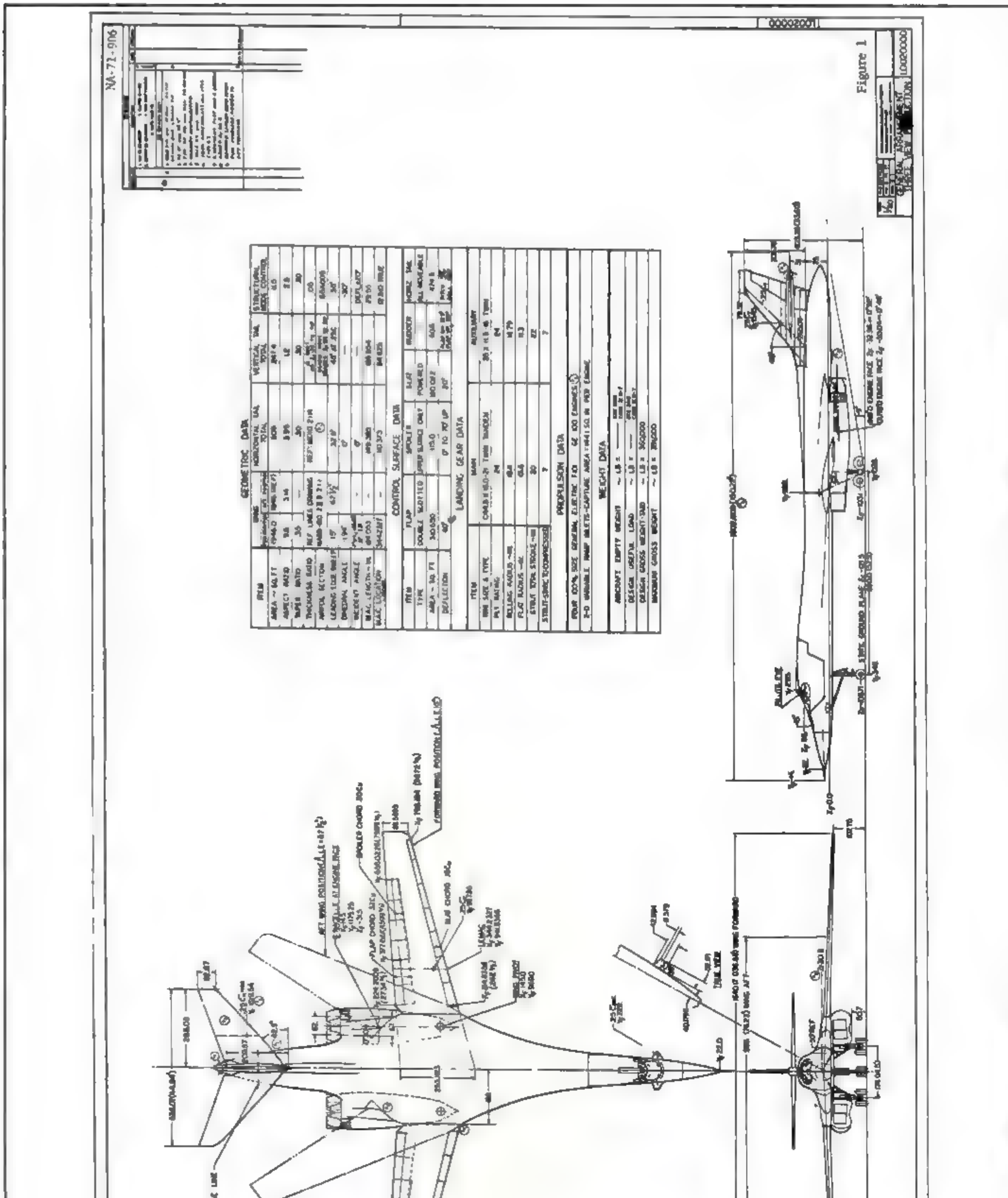
Similar stability fins had been tested as exciter vanes on XB-70A number one during 1968. Using them, NASA studied the effects of air turbulence on large aircraft traveling at high speed. Specifically, as these fins and their operating components were developed, the teeth-jarring aspects of air turbulence of crews manning large aircraft flying close to the ground were for the most part eliminated.

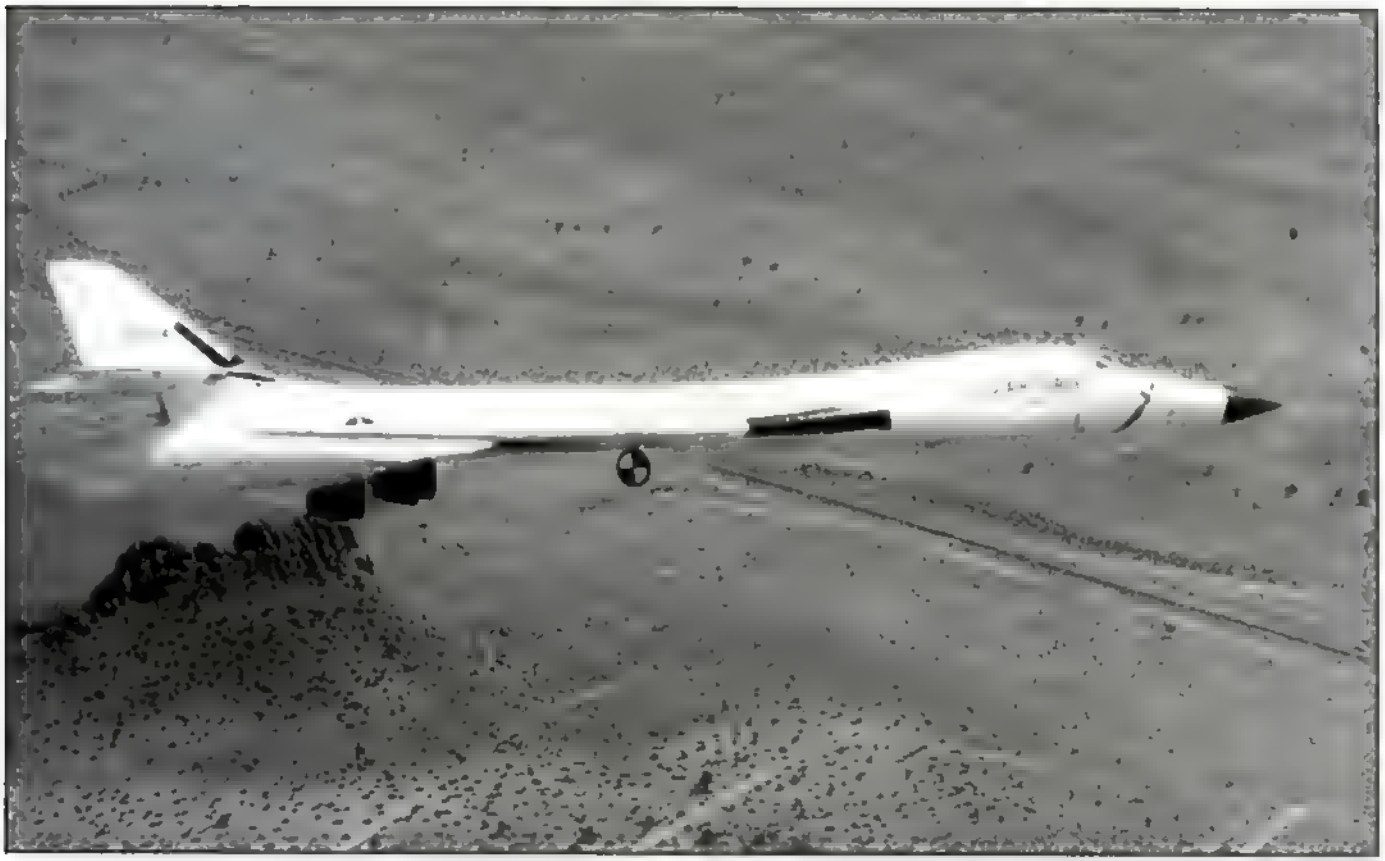
B-1B Powerplant

The B-1B is powered by four afterburning 30,780 pound-thrust turbofan engines built by General Electric Aircraft Engine Group in Lynn, Massachusetts. Designated F101-GE-102, this powerplant is an improved version of the F101-GE-100 engine that was tested during the B-1A flight test program.

The F101-GE-102 full-scale development (FSD) program began in October 1981. During April 1982 General Electric received a production contract for 428 engines, in addition to the 41 engines ordered when development began. The first production engine was shipped to North American in September 1983, and the flight qualification test was completed in June 1986. Flight test demonstrated that the -102 engine produces 6% more thrust than specifications required, and uses 3% less fuel.

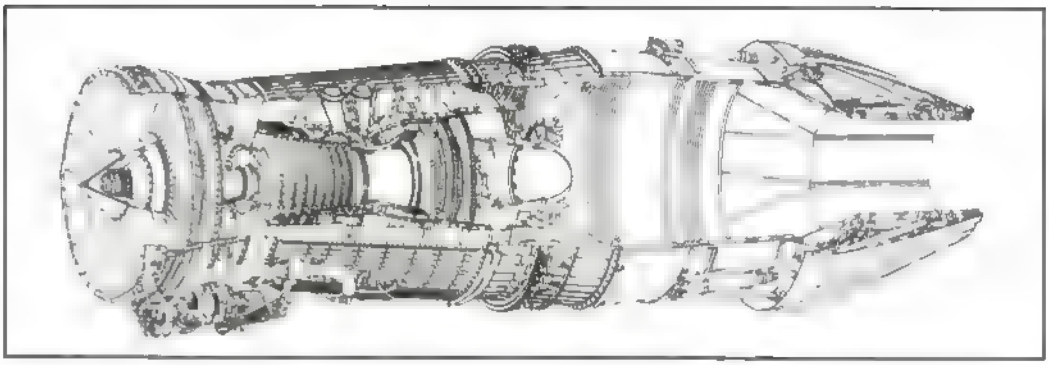
The F101-GE-102 weighs 4,400 pounds (dry), and feature a modular design to facilitate repair. In order to maximize availability, the -102 engine also features a central integrated test system (CITS) interface which permits continuous engine condition monitoring.


NA-71-906
GEOMETRIC DATA
CONTROL SURFACE DATA
LANDING GEAR DATA
PROPULSION DATA
WEIGHT DATA
Figure 1

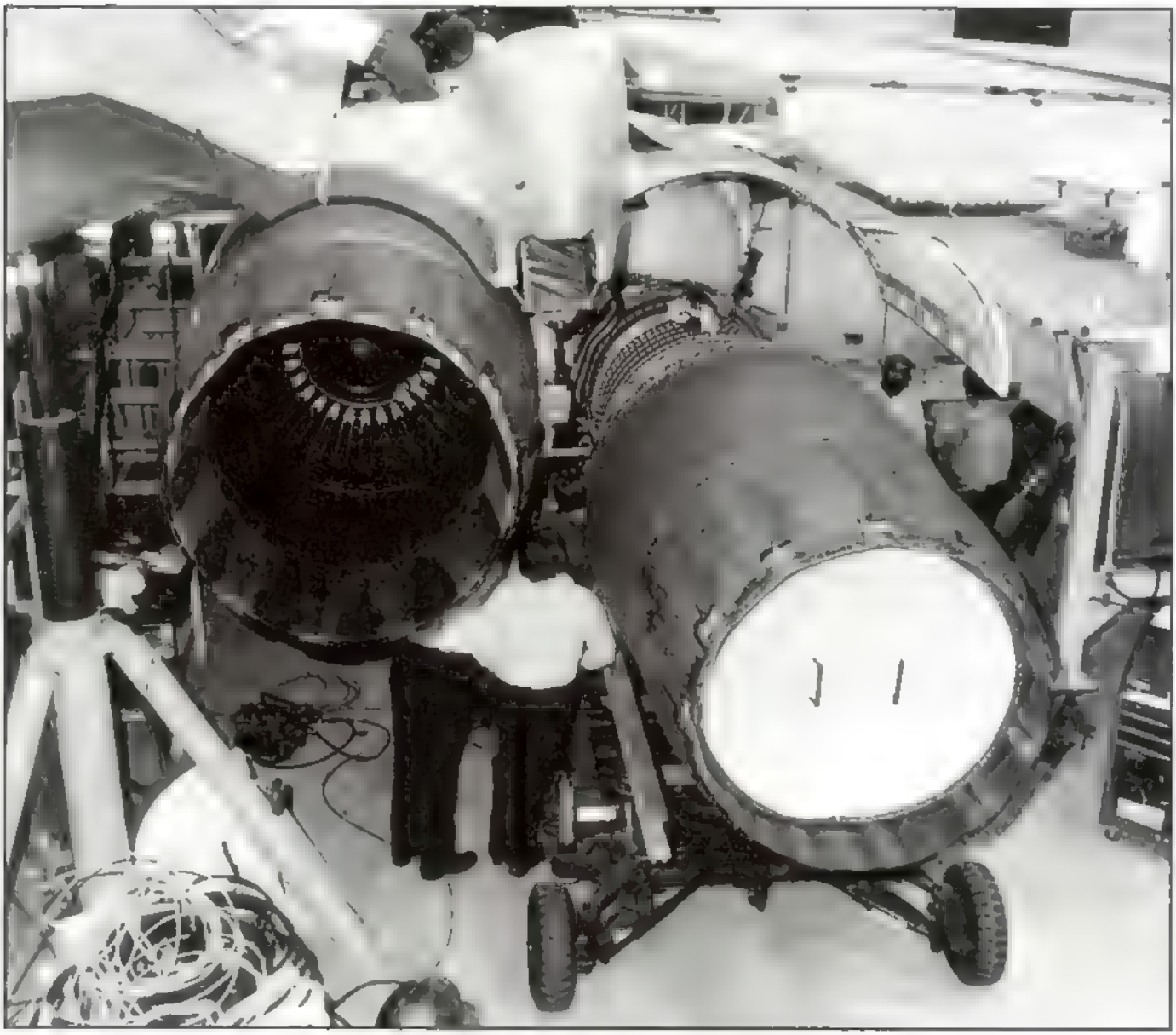


B-1A number four's sixth flight occurred on 18 April 1979. It was the first "A" model to be equipped with individual ejection seats for its four crew members. (Boeing North American)

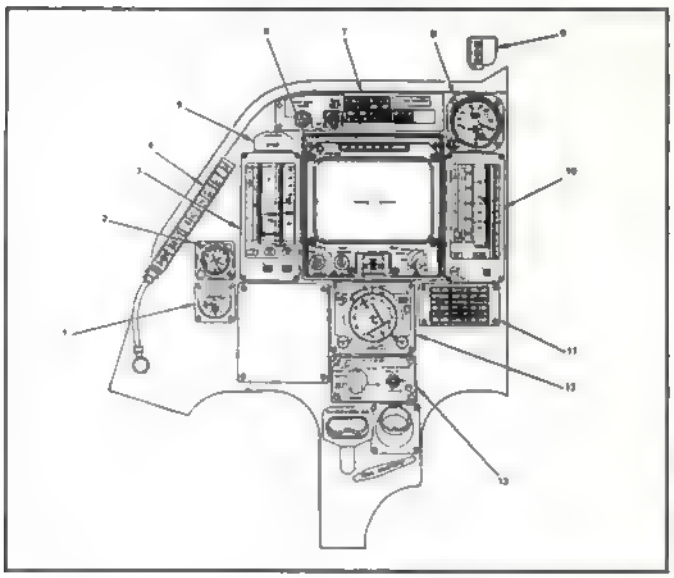
In its desert camouflage scheme, B-1A-3 is shown here on its 138th flight. It was the last B-1 aircraft to be equipped with the self-contained, four-man crew escape capsule. (Boeing North American)



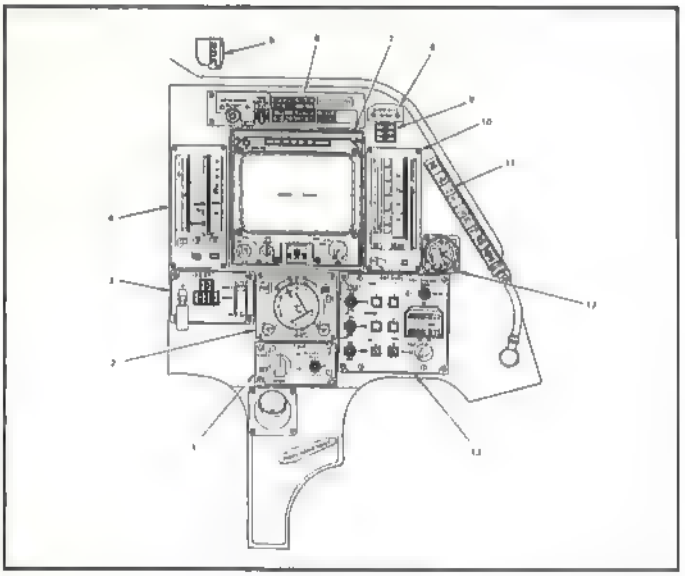
General Electric's F101-GE-102 augmented turbofan for the B-1B has a low-pressure system consisting of a fan and a two-stage uncooled turbine. The fan has variable inlet guide vanes and produces a pressure ratio of about two. The high-pressure system, or core engine, consists of a nine-stage axial flow compressor with variable stators, an annular-type combustor with an atomizing fuel-injector system, and a single-stage, air-cooled turbine. (General Electric)



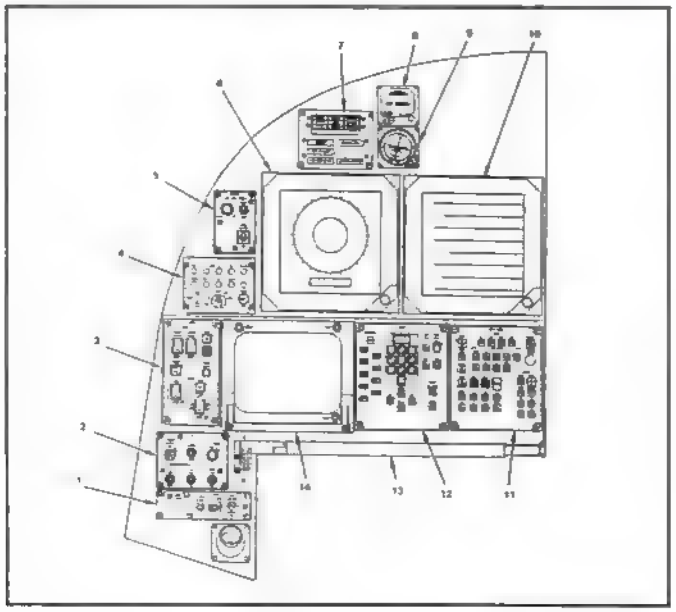
As B-1A number one nears completion, the number three and four YF101-GE-100 engines were installed in preparation for first flight. (Boeing North American)



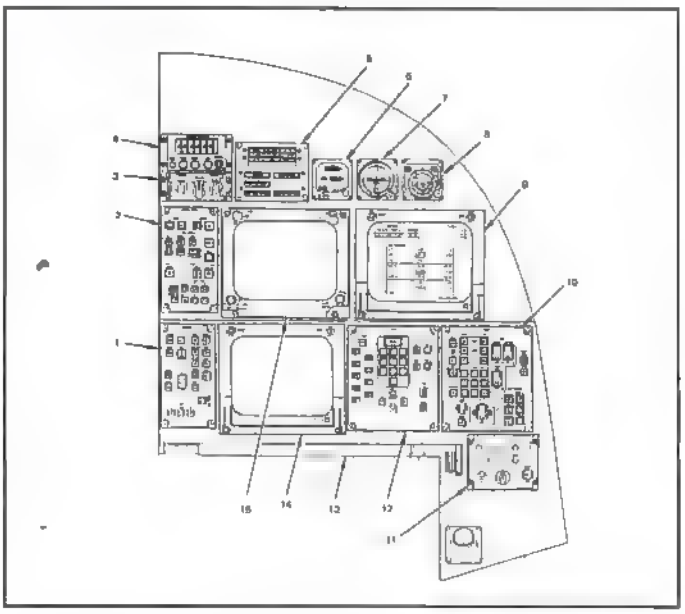
B-1B pilot's panel:1) total temperature indicator; 2) clock; 3) airspeed and Mach number indicator; 4) automatic flight control system control panel; 5) aircraft radio call placard; 6) vertical situation display; 7) master caution panel; 8) radar altimeter; 9) angle of attack and indexer lights; 10) altitude and vertical velocity indicator; 11) auxiliary caution panel; 12) horizontal situation indicator (HSI); and 13) flight director control panel. (US Air Force)



B-1B copilot's panel: 1) flight director control panel; 2) HSI; 3) landing gear control panel; 4) copilot's airspeed/Mach indicator; 5) AOA and indexer lights; 6) copilot's master caution panel; 7) VSD; 8) radio call placard; 9) marker beacon lights; 10) altitude and vertical velocity indicator; 11) AFCS control panel; 12) clock; and 13) external fuel control panel. (US Air Force)



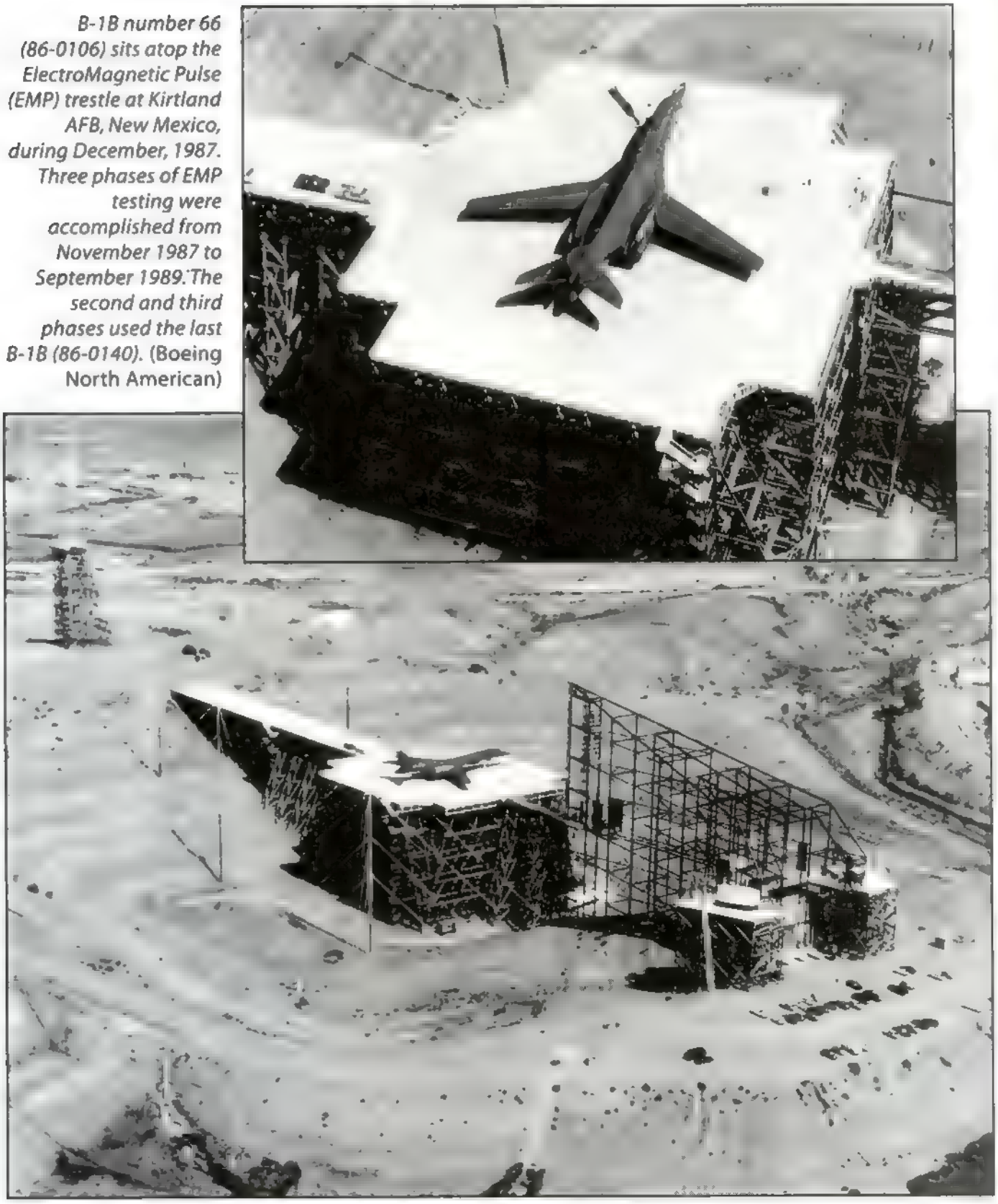
B-1B defensive system operator's (DSO) console: 1) electrical multiplex or EMUX system controls; 2) lighting controls; 3) power controls; 4) intercom; 5) environmental controls; 6) left MFD; 7) caution panel; 8) flight parameter indicator; 9) attitude indicator; 10) right electronic display unit; 11) AN/ALQ-161A (RFS/ECMS) controls; 12) integrated keyboard; 13) work table; and 14) MFD. (US Air Force)



B-1B offensive system operator's (OSO) console: 1) radar controls; 2) BOMB/NAV controls; 3) rendezvous beacon controls; 4) coded switch controls; 5) caution panel; 6) flight parameter indicator; 7) attitude indicator; 8) horizontal situation indicator; 9) right MFD; 10) stores management; 11) intercom; 12) integrated keyboard; 13) work table; 14) bottom MFD; and 15) radar display unit. (US Air Force)

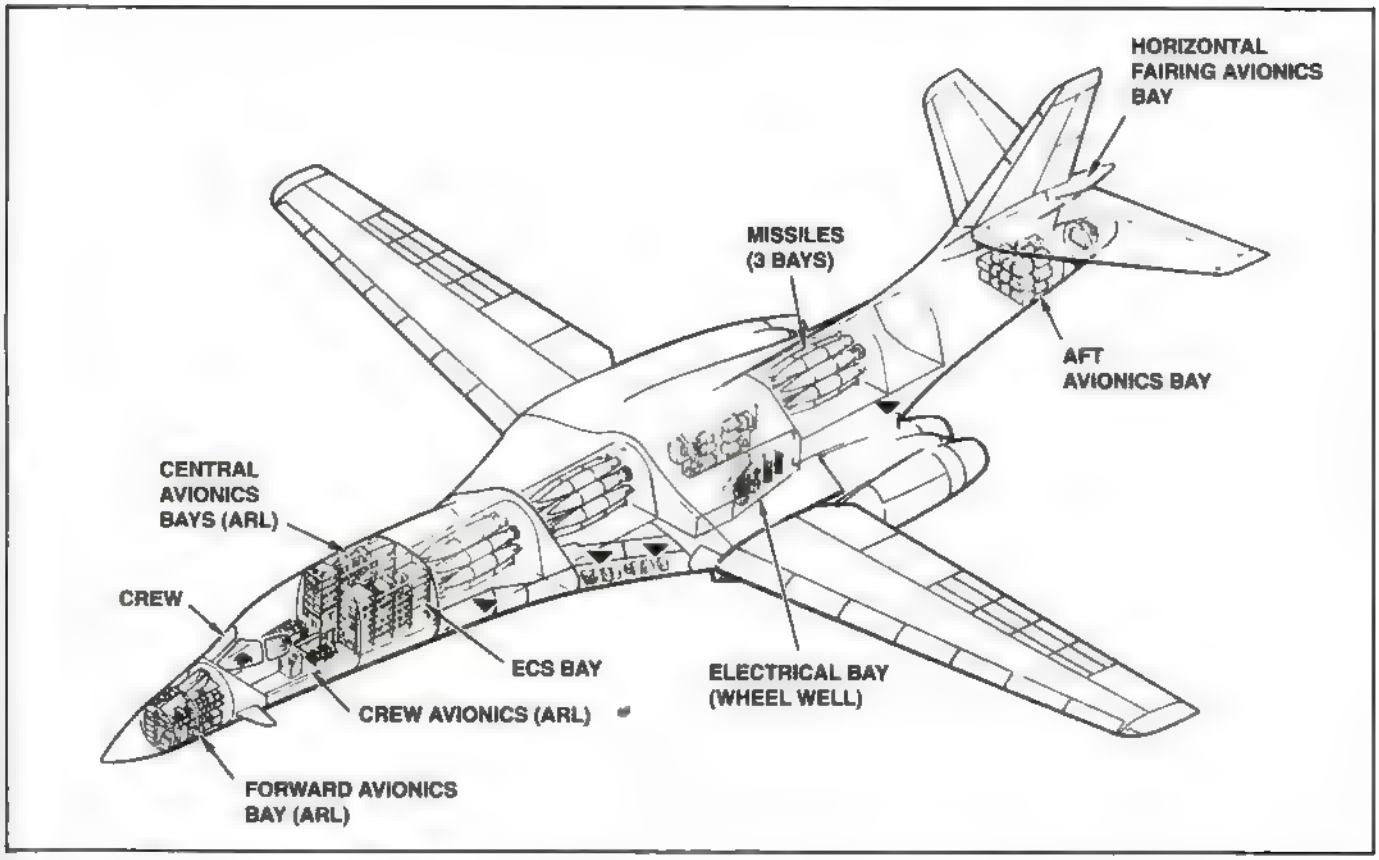
Painted in European camouflage B-1A-2, as B-1B flight test aircraft number one, flies near Edwards AFB on 1 January 1984. (US Air Force)

As it approaches its refueling aircraft, this B-1B offers an extremely close-up view of the wing-to-body-blending that allows the aircraft to perform so well at all altitudes, whether it be 200 feet off the deck or in the stratosphere at 50,000 feet. (Boeing North American)

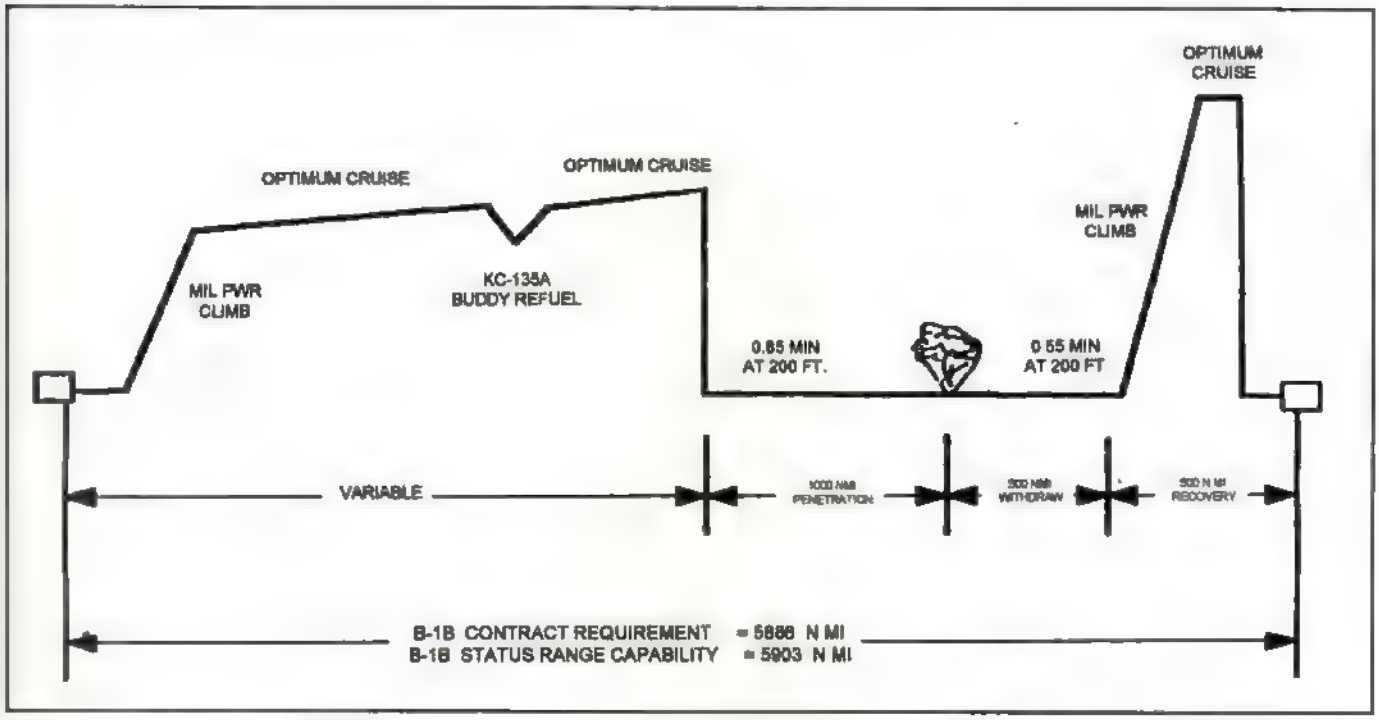


B-1B number 66 (86-0106) sits atop the ElectroMagnetic Pulse (EMP) trestle at Kirtland AFB, New Mexico, during December, 1987. Three phases of EMP testing were accomplished from November 1987 to September 1989. The second and third phases used the last B-1B (86-0140). (Boeing North American)

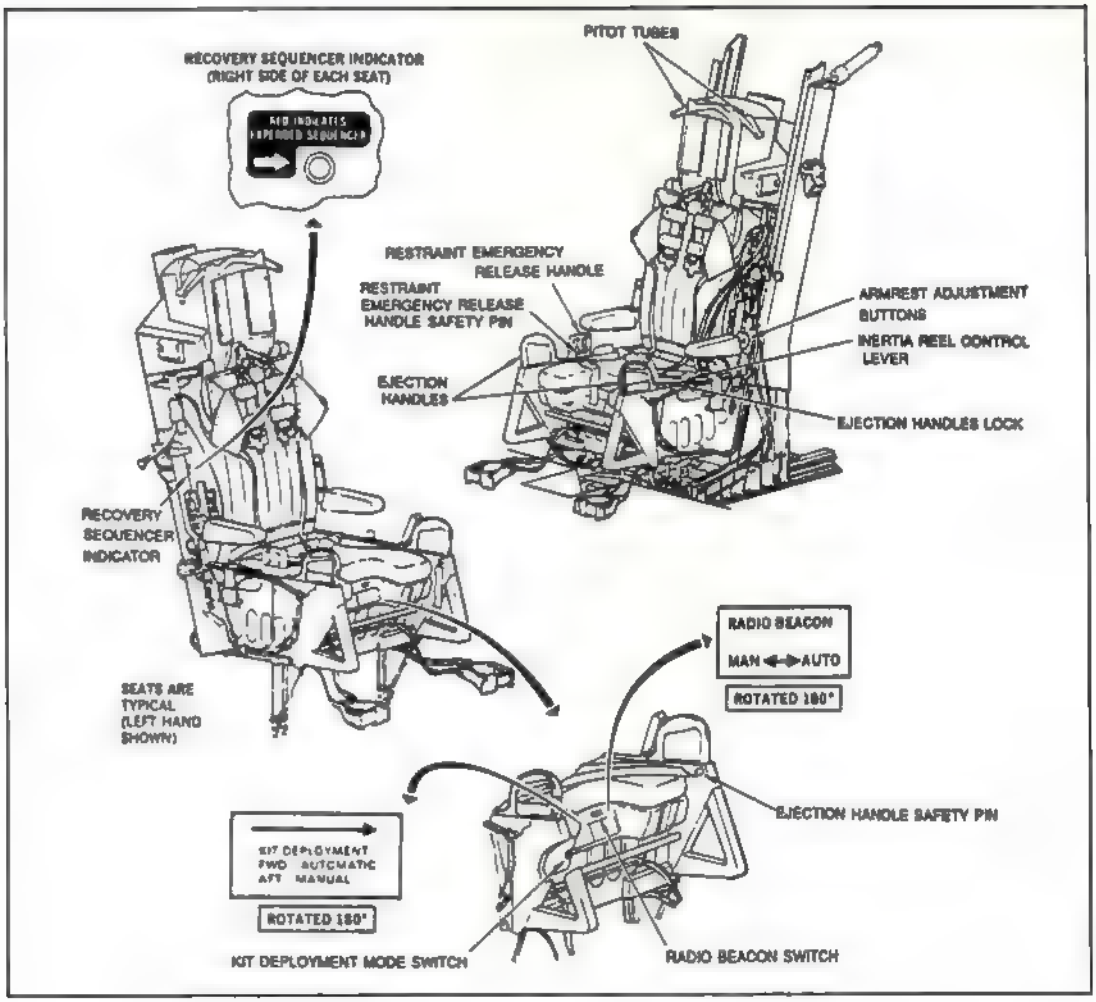
Kirtland AFB, Albuquerque, New Mexico, is home of the "Trestle" which the Air Force uses for EMP evaluation of its large combat aircraft. Two different B-1Bs participated in EMP testing here—86-106 and 86-0140. (Boeing North American)



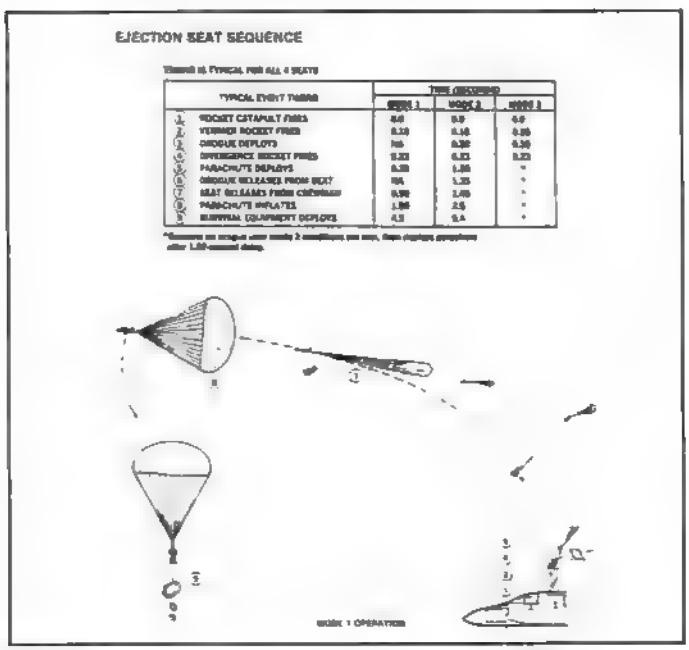
Almost every square inch of the B-1B's fuselage is occupied by mission equipment. Three weapons bays, five avionics bays, one electrical bay, an environmental control system (ECS), and the crew compartment are all squeezed into the 143-foot long fuselage. (Boeing North American)

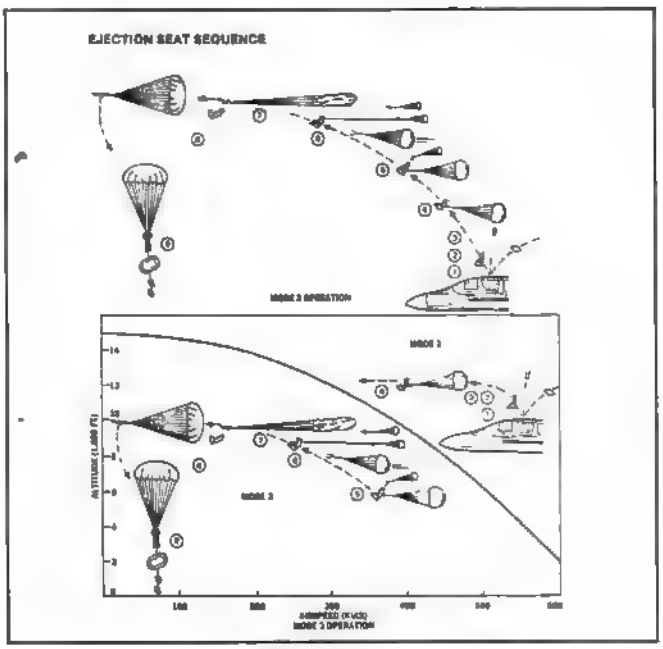


The B-1B's SIOP design mission profile. (Boeing North American)



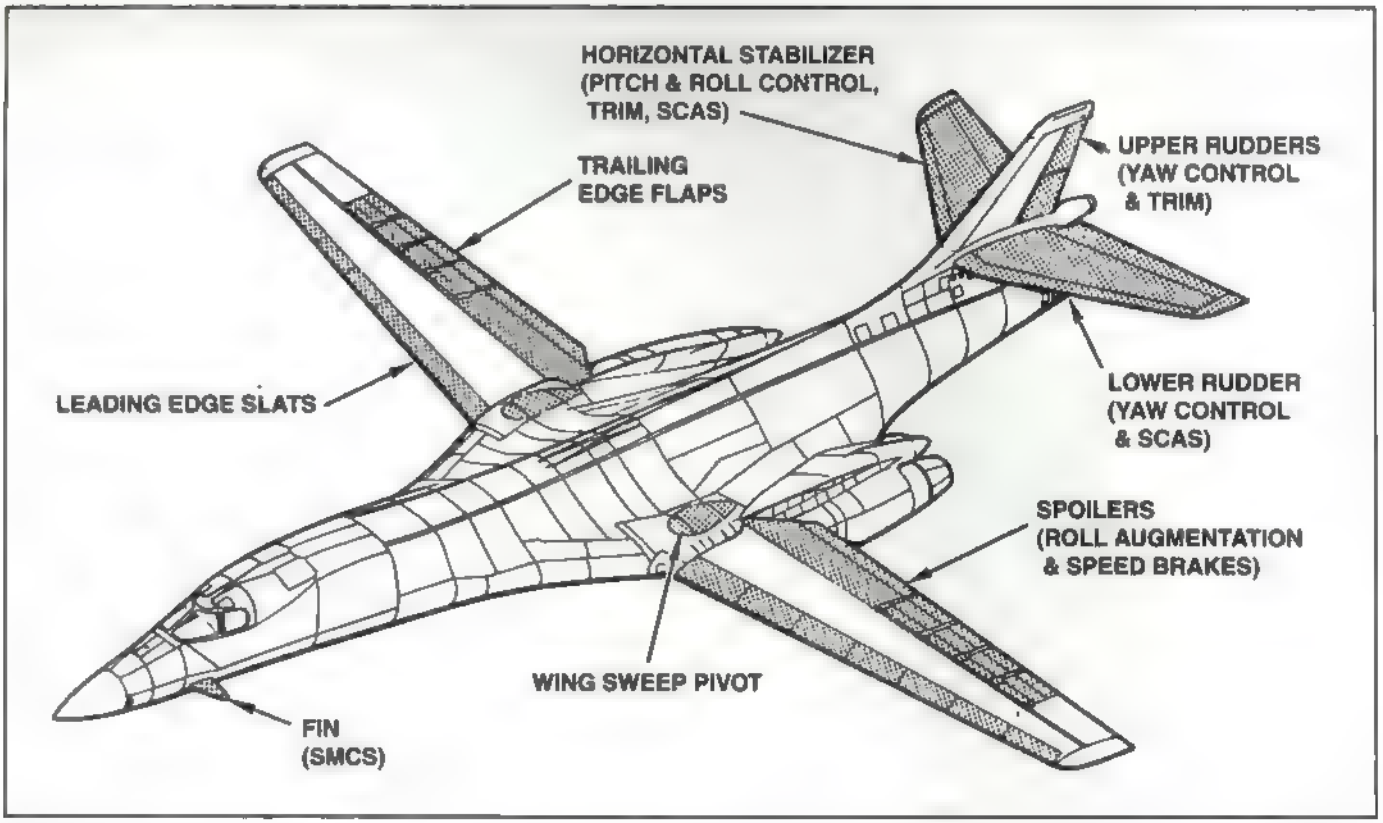
Each of the B-1B's four crew members has a Boeing advanced concept ejection seat II (ACES II). Each fires upward through the roof of the Lancer's crew cabin. (US Air Force)





There are three ejection seat sequences for the B-1B called Modes One through Three. In Mode Two for example, from the time the seat's rocket motor fires to eject the ACES II seat upwards and out of the aircraft, to the time that the onboard survival equipment deploys, only 5.4 seconds will elapse. (US Air Force)

The coveted Robert J. Collier Trophy was awarded to the Air Force, Rockwell International, and the B-1A industry team in 1976. This award is the most prestigious in American aviation. (Boeing North American)



The movable flying control surfaces on the B-1B Lancer are numerous, and in most cases, quite large. As shown in this illustration they are comprised of two wing sweep pivot drives, leading- and trailing edge wing slats and flaps, two Structural Mode Control System (SMCS) fins, spoilers for both rolling maneuvers and speed brakes, a lower rudder for yaw control and Stability and Control Augmentation System (SCAS) employment, two upper rudders for yaw control and trim, and two horizontal stabilizers for pitch and roll control, trim, and SCAS functions. (Boeing North American)

After manufacture and roll-out, every production B-1B had to undergo a lengthy list of checkout procedures before they were cleared for flight. Here, on the Palmdale flight line, several B-1Bs are shown during their respective preflight evaluations. (Boeing North American)

An aerial view looking west of the Rockwell International B-1B production factory complex at Air Force Plant 42. The large facility in the background was originally built to manufacture the L1011 airliner, and is now the home of Lockheed Martin Skunk Works. (Boeing North American)

US Air Force Plant 42 at Palmdale, California, is a very large aircraft manufacturing and flight test complex. This photo, with four B-1Bs in view, shows where all 100 of the Boeing North American B-1Bs were built. The building on the right (#704) is currently being used to build the Lockheed Martin X-33 demonstrator. (Boeing North American)

Boeing North American B-1B Lancer Production

Serial Number	Delivery	Aircraft Name(s)
Fiscal Year 1982		
82-0001	06-29-85	*Leader Of The Fleet*; has been at Ellsworth AFB, South Dakota, since 2 August1988; it has been removed from flying status and is used as a static weapons loading trainer.
Fiscal Year 1983		
83-0065	06-17-85	*Star Of Abilene* (temporarily Star Of Palmdale)
83-0066	10-16-85	*Ole' Puss*
83-0067	01-13-86	*Texas Raiders*
83-0068	02-18-86	*Spuds* (McKenzie; named after the Budweiser beer dog)
83-0069	03-13-86	*Silent Penetrator* (note improper spelling), *Rebel*
83-0070	05-06-86	*Shack Master, 7 Wishes*
83-0071	05-24-86	*Grand Illusion*
Fiscal Year 1984		
84-0049	06-06-86	*Thunder From The Sky*; "Dedicated to the City of Palmdale" (California)
84-0050	10-01-86	*Surf Rat, Surprise Attack*
84-0051	07-30-86	*Lucky Lady, Boss Hawg*
84-0052	07-11-86	Never named; crashed to destruction on 28 September 1987; three crew members perished; three survived
84-0053	07-10-86	*Lucky 13*
84-0054	07-26-86	*Silver Bullet, Tasmanian Terror*
84-0055	08-22-86	*Ridge Runner, Sunrise Surprise*
84-0056	08-27-86	*Sweet Sixteen*
84-0057	04-30-87	*The Hellion*; crashed to destruction of 18 February 1998; all crew members bailed out and survived
84-0058	03-26-87	*Master Of Disaster*
Fiscal Year 1985		
85-0059	09-26-86	*Super Glider, Better Duck*
85-0060	10-31-86	*Night Hawk*
85-0061	03-18-87	*French Connection*
85-0062	11-04-86	*Sky Dancer*
85-0063	11-30-86	Never named; crashed to destruction on 8 November1988; all four crew members survived
85-0064	11-03-86	*Eliminator*
85-0065	11-30-86	*Trilogy Of Terror, Texas Armor*
85-0066	12-31-86	*Special Delivery, Missouri Miss*
85-0067	12-30-86	*Wild Thang, Miss Behavin*
85-0068	11-16-86	*Spuds*
85-0069	12-23-86	*Silent Penetrator, Daisy Mae*
85-0070	01-07-87	*Excalibur*
85-0071	02-04-87	*Liberator*
85-0072	02-27-87	*Polarized*

85-0073	01-13-87	*Wings Of Freedom, Cerberus*
85-0074	02-18-87	*Penetrator*
85-0075	03-21-87	*Banshee*
85-0076	03-19-87	*Blackjack*; crashed to destruction on 17 November 1988; all four crew members survived
85-0077	02-13-87	*Bones, Jap Happy, Hampton*
85-0078	02-21-87	*Heavy Metal*; crashed to destruction on 19 September 1997; all crew members perished
85-0079	03-13-87	*Warriors Dream, Classy Lady*
85-0080	03-13-87	*Lady Of The Nite, Gate Keeper, Screamin' Demon*
85-0081	04-01-87	*Equalizer*
85-0082	03-23-87	*Gunsmoke*
85-0083	03-30-87	*Dark Star*
85-0084	04-17-87	*Pandoras Box*
85-0085	05-04-87	*America 1*
85-0086	04-22-87	*My Mistress*
85-0087	05-01-87	*Gremlin*
85-0088	06-22-87	*Phoenix*
85-0089	06-22-87	*Midnight Prowler*
85-0090	05-14-87	*Trail Blazer*
85-0091	06-03-87	*Thor*
85-0092	06-17-87	*Enforcer*
Fiscal Year 1986		
86-0093	07-27-87	*Ruthless Raven, Global Power*
86-0094	07-31-87	*Night Hawk*
86-0095	06-02-87	*Mystique, Undecided*
86-0096	07-02-87	*Thunder Child*
86-0097	06-25-87	*Iron Eagle*
86-0098	07-15-87	*Freedom I*
86-0099	08-03-87	*Ghost Rider*
86-0100	07-20-87	*Phantom, Night Hawk*
86-0101	08-21-87	*Iron Butterfly, Low Level Devil*
86-0102	08-31-87	*Lady Hawk*
86-0103	09-08-87	*Huntress, Lovely Lady*
86-0104	08-24-87	*American Flyer*
86-0105	09-24-87	*Snake Eyes*
86-0106	09-05-87	*Lone Wolf*; crashed to destruction on 30 November 1992
86-0107	10-26-87	*Vindicator, Defendus Libiteros, Valkyries*
86-0108	11-30-87	*Hawk*
86-0109	10-01-87	*Spectre*
86-0110	09-19-87	*Sunrise Surprise*
86-0111	10-16-87	*Ace In The Hole*
86-0112	10-28-87	*Vanna*
86-0113	11-17-87	*Viper*
86-0114	12-09-87	*Wolfhound*
86-0115	11-05-87	*Bump And Run, Top Secret*
86-0116	12-02-87	*Victress*

86-0117	12-04-87	*Pride Of North Dakota*
86-0118	11-18-87	*Iron Mistress*
86-0119	12-02-87	*Christine*
86-0120	12-22-87	*Mad Dawg*
86-0121	01-05-88	*Exterminator, Terminator, Zeppelin, Maiden American*
86-0122	01-12-88	*Excalibur*
86-0123	01-08-88	*Molester, Lester, High Noon*
86-0124	01-04-88	*Winged Thunder*
86-0125	02-04-88	*Shack Attack*
86-0126	02-03-88	*The Gun Fighter, Minotaur, Command Decision*
86-0127	02-05-88	*Freedom Bird, Ivan's Nightmare, Nightmare*
86-0128	04-05-88	*The HAWK* (acronym for Holiday And Weekend Killer), *Miss Behavin*
86-0129	02-26-88	*Pegasus*
86-0130	03-03-88	*The Rose, Bad Company*
86-0131	03-16-88	*The 8th's Wonder, Ultimate Warrior*
86-0132	08-20-88	*The Wizard, Oh Hardluck*
86-0133	04-14-88	*Big Bird, The Outlaw*
86-0134	03-24-88	*Green Hornet, Night Mission, Wild Ass Ride*
86-0135	04-28-88	*Make My Day, The Watchdog*
86-0136	04-15-88	*Special Delivery*
86-0137	04-29-88	*Wichita Express*
86-0138	04-24-88	*Easy Rider Too, Grand Illusion II*
86-0139	04-29-88	*Gallant Warrior*
86-0140	05-02-88	*The Valda J* (for Maj Valda J. Robbins who flew all 100 B-1B Air Force acceptance flights at Palmdale), *Peace Warrior*

Note: The aircraft names shown above are subject to change as new aircraft commanders are assigned to them.

Boeing North American B-1B Lancer Specifications

User Service:	United States Air Force, Strategic Air Command (until 1 June 1992); then Air Combat Command (beginning 1 June 1992)
Wing Span:	136 feet, 8.5 inches fully extended; 78 feet, 2.5 inches fully swept aft
Wing Area:	1,950 square feet (approximate)
Length:	150 feet, 2.5 inches with nose boom; 143 feet, 3.5 inches without nose boom
Height:	33 feet, 7.25 inches
Gross Weight:	477,000 pounds
Empty Weight:	190,000 pounds (approximate)
Payload:	125,000 pounds
Powerplant:	Four augmented General Electric 30,000 pounds-thrust class (30,780 lbf actual) F101-GE-102 turbofans
Maximum Speed:	Mach 1.25 at 50,000 feet; Mach 0.92 at 200 to 500 feet
Crew:	Four: pilot, copilot, defensive systems operator and offensive systems operator
Maximum Range:	7,455 miles (without in-flight refueling)

B-1As and B-1Bs in Color

From the Wings of a Snow-White Dove to a Workhorse for Peace

When the first B-1A appeared in the fall of 1974, the U.S. Air Force (particularly its Strategic Air Command) was thrilled to believe that it finally had the genesis to a modern fleet of strategic bombardment aircraft. But that goal faded away in the summer of 1977. Then in the fall of 1981, thanks to America's new strategic modernization policy, a new advanced version of the B-1A was ordered. And finally, although it did not get the 240-plus B-1As it originally wanted, SAC (now ACC) did get 100 B-1Bs: the last one delivered in the spring of 1988. Operational now for 13 years, the B-1B has more than asserted itself as the multi-role, long-range combat aircraft that it was created to be. Though it has not yet participated in any military conflict as of this writing, there is no doubt that it could do so effectively. In fact, in November 1997, a pair of B-1Bs were sent to the Persian Gulf region during Iraq's ongoing lack of cooperation with United Nation inspectors. The B-1B Lancer, with its ability to deliver standoff weapons, nuclear ordnance, and conventional ordnance from either low- or high-altitude, is truly a needed warbird.

Looking somewhat more like the "Millennium Falcon" featured in the trilogy of Star Wars movies than a strategic bomber, the second of two North American XB-70A Valkyrie aircraft soars through the skies near Edwards in early 1966. Until the downing of Power's U-2 in May 1960, this was the type of bomber the Air Force wanted. The B-70 was projected to fly at a maximum speed of Mach 3.2 (more than 2,000 mph) and a maximum altitude of 95,000 feet (more than 17.9 miles). When the first XB-70A rolled out in May 1964 the Air Force was already planning for the AMSA (B-1A) due to changing mission requirements for strategic bombers. The B-1A was optimized for high- or low-level penetration of enemy airspace, and the XB-70A for high-level attacks. Thus the XB-70A's mission became research for America's proposed Supersonic Transport (SST), which was never built. (Boeing North American)

Roll-out! Hundreds of Rockwell employees and invited guests surround the first of four B-1A prototype aircraft during its official roll-out ceremony nearly 24 years ago, on 26 October 1974. (Boeing North American)

The first flight of B-1A number four occurred on 14 February 1979. Note the black leading edges on the wing root fairings. The two rectangular outlines on top of the fuselage are the chaff/flare dispensers. (Boeing North American)

In this view of B-1A number one, taken on 18 December 1974, just five days before its maiden flight, the aircraft is shown as it begins to decelerate after a taxi test at Palmdale. Having no braking parachute, the B-1A and the B-1B rely partially on the horizontal tailplanes which, as illustrated, deflect downward to assist in the braking process. (Boeing North American)

Various camouflage paint schemes were applied to all four of the B-1A aircraft. This is just one scheme applied to B-1A number three. The B-1A aircraft had suddenly traded its snow-white dove appearance for a more business-like look. (Boeing North America)

Its four F101 turbofan engines ablaze during a night-time runup at Palmdale, a Rockwell photographer who had obviously used a sparkle filter to good advantage captured B-1B number one as it roared to life under a three quar ter moon prior to its first flight on 18 October 1984. (Boeing North American)

Wings swept to their full-aft position of 67.5°, a Lancer demonstrates a 90° bank to the right during an air show fly-by at Palmdale, circa mid-1986. B-1B pilots agree that it handles more like a fighter than a bomber. (Boeing North American)

A US Air Force B-1B Lancer bomber receives an in-flight refueling from a KC-10 Extender as the two aircraft fly over the Mediterranean Sea on 24 November 1997. The Lancer joined a large force of over 170 US Air Force aircraft in the region providing support to Operation Southern Watch which is the US and coalition enforcement of the no-fly-zone over Southern Iraq. The long-range heavy bomber is deploying to the Persian Gulf area of operations from the 37th Bomb Squadron, Ellsworth Air Force Base, South Dakota. (DoD photo by SSgt. Efrain Gonzalez, US Air Force)

PREPARING FOR COMBAT

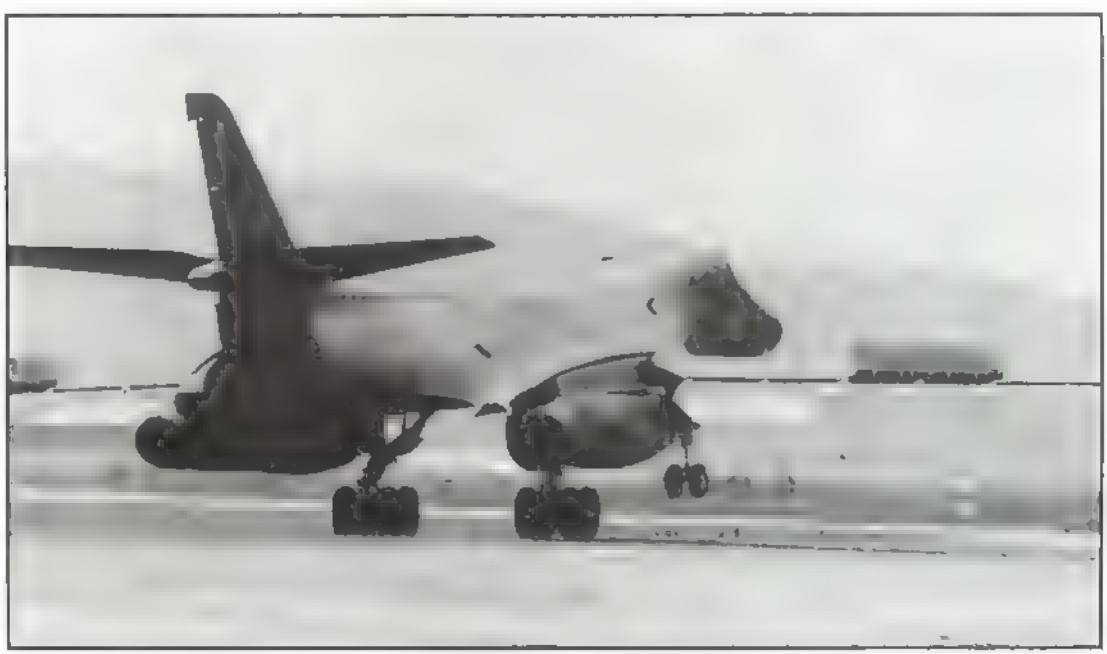
INITIAL OPERATIONAL CAPABILITY—IOC

The second production aircraft (83-0065) was the first B-1B to be delivered to SAC, on 27 June 1985 after a flight from Edwards AFB, to Offutt AFB, Nebraska. A ceremony was planned for 29 June at Dyess AFB, Texas, where the aircraft was scheduled to be presented to the first operational B-1B unit, the 96th Bomb Wing (BW). This would also mark the 30th anniversary of the first B-52 delivery to SAC back in 1955. But the aircraft suffered foreign object damage (FOD) to one of its engines while at Offutt.

Not wanting to delay the ceremony while the engine was repaired, SAC arranged for the first prototype B-1B (82-0001) to be flown from Edwards directly to Dyess. There the aircraft was ceremoniously, if temporarily, delivered to the 96th BW on schedule. Finally on 7 July 1985, after its FOD situation had been addressed, the second B-1B arrived at Dyess and was officially turned over to the 96th Bomb Wing, 4018 Combat Crew Training Squadron (CCTS). Because of Dyess' proximity to Abilene, the aircraft was appropriately named *Star of Abilene*. Shortly thereafter, B-1B number one returned to Edwards AFB to continue with its ongoing test activities.

The B-1B's initial operational capability (IOC) occurred on 1 October 1986 when the aircraft went on alert for the first time with the 96th BW at Dyess. In the 14 months since the *Star of Abilene* had been delivered, SAC had received 15 production B-1Bs. Aircraft were rolling off the production line regularly, but progress on perfecting the complex offensive and defensive avionics was slow. Although the B-1B had been declared operational, it was far from ready to fight.

The year 1987 was filled with B-1B developments. Beginning on 16 January, B-1B number one performed the first AGM-69 SRAM launch while flying at a speed of Mach 0.9 and an altitude of 500 feet. The 28th BW at Ellsworth AFB, South Dakota, received its first B-1B (85-0073) on 21 January. On 14 April, a B-1B (85-0072) from the 96th BW (appropriately named *Polarized*) flew the North Pole Endurance Mission, covering 9,411 miles in 21 hours and 40 minutes. During the flight the B-1B had come within 160 miles of Russia. A 28th BW B-1B (85-0098 – *Freedom I*) set 18 world-class distance, payload, and speed records on 4 July as it flew over the Pacific Ocean near Vandenberg AFB, California. That accomplishment was bolstered on 18 September when the 96th's *Sun-*



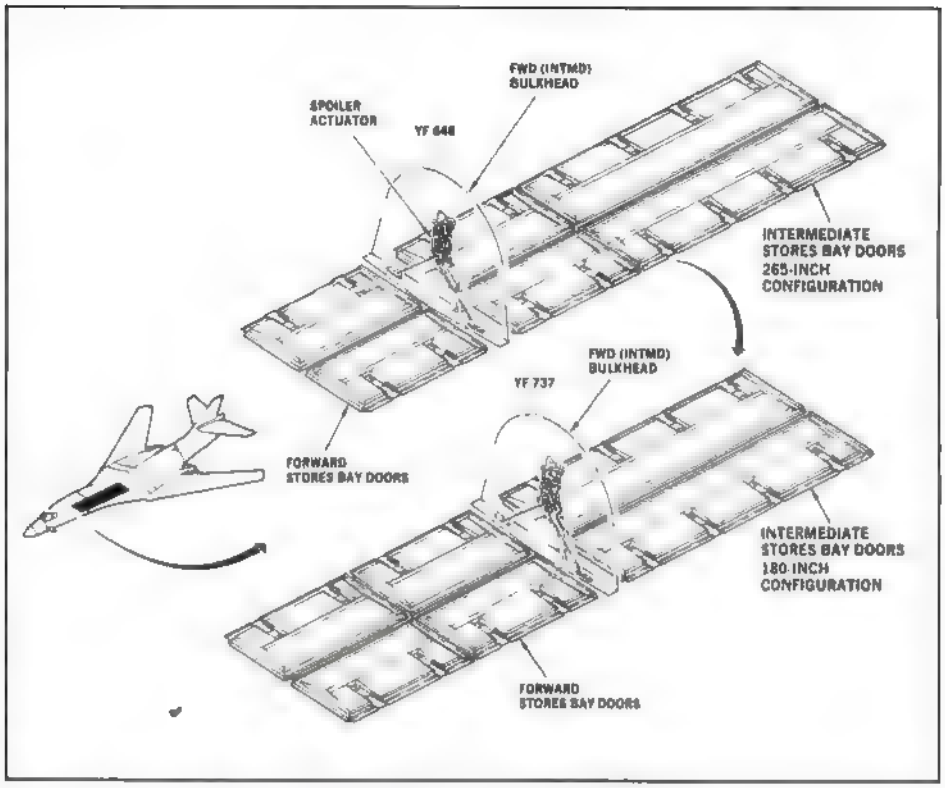
Touchdown! Flaps down, spoilers deployed, and horizontal tailplane deflected, a tri-motor B-1B of the 96th BW (now 7th BW) at Dyess AFB returns to Palmdale to get another engine number three (inboard engine on right side), which is missing from the aircraft. (Boeing North American)

This B-1B (86-0093) was delivered to the 28th BW at Ellsworth AFB, South Dakota, on 27 July 1987. It was given the name Ruthless Raven *and, on 24 March1992, was involved in a mid-air collision with a KC-135R refueling aircraft over Nebraska. Both aircraft suffered extensive damage but returned safely to their base. Both aircraft were repaired and returned to service.* (Boeing North American)

rise Surprise (86-0110) set another 18 world-class distance, payload, and speed records over a number of west coast states. The 319th BW at Grand Forks, North Dakota, received its first B-1B (86-0110) on 19 September.

The first B-1B loss occurred on 28 September 1987 when the 12th production aircraft (84-0052) suffered what is believed to have been a bird strike. The aircraft was on a low-level training flight over the Radar Bomb Sight Range at La Junta, New Mexico. Since this was a training flight, the aircraft carried more than its normal complement of four crew members. Two additional officers were using the "jump seats" to observe operations. Unfortunately, these are not ejection

Following a successful manufacturer's test flight, the number two B-1B (83-0065) taxis back to the ramp at Palmdale, circa mid-1985. Named the Star of Abilene, *it was delivered to the 96th BW (now 7th BW) at Dyess AFB, on 1 June 1985. Temporarily renamed the* Star of Palmdale *while at Palmdale from late 1987 to early 1988 for modifications, the aircraft was again named* Star of Abilene *upon its return to Dyess in mid-1988.* (Boeing North American)



The two forward weapons bays can be divided into a variety of different configurations. Essentially, the forward bay can be cut in half, with the rear half added to the intermediate weapons bay. This allows the B-1B to carry weapons that are longer than the normal size of the weapons bays. (US Air Force)

seats, leaving these crew members no means of escaping the aircraft. Further, one of the normal four ejection seats failed to operate correctly, resulting in the death of three of the six crew members.

The year 1987 concluded with a milestone of sorts when a B-1B (85-0064) of the 96th BW flew its 100th sortie out of Dyess AFB on 17 December, the 84th anniversary of the Wright Brothers' first flight.

Like most previous strategic bombers since the end of the World War II, the B-1B's first order of business was delivering nuclear weapons. But the world political climate began to change, and the Department of Defense began to put increased emphasis on the ability to fight limited wars. Soon after the B-1B had been cleared to carry and deliver most US nuclear weapons, work began to modify the aircraft to carry non-nuclear weapons for conventional warfare. Included in this capability are conventional free-fall bombs, and various configurations of conventionally-armed cruise missiles. This action likely contributed to the cancellation of the nuclear-capable Boeing AGM-131A SRAM II program by the Bush Administration. The SRAM II was to be a much improved version of the original AGM-69A SRAM.

Photographed through the DSO's window on the left-hand side of the aircraft, this B-1B's shadow races along side at Mach 0.90 just 200 feet above the Mojave Desert. (Mike Machat Illustration)

The flexible glove above the outboard engines allow the inboard section of the wing to fit snugly when at full aft sweep. Here the wing is in its full-forward (15°) position, and the trailing edge flaps are fully extended. Note the "closed" position of the convergent-divergent engine exhaust nozzles. (Boeing North American)

On 17 July 1991, a B-1B (86-0099) from the 28th Bomb Wing successfully dropped 84 500-pound Mk 82 iron bombs over the Utah Test Range (UTTR) while flying at Mach 0.85 and 500 feet. This was the final test in the initial B-1B non-nuclear weapon certification process. Subsequently, on 27 September 1991 all B-1Bs were removed from nuclear alert status, and were classed as a "conventional" weapon under various international arms reduction treaties.

The Strategic Air Command had been established on 21 March 1946 to provide America's first line of defense during the Cold War. With the fall of the Soviet Union, its mission was largely complete. On 1 June 1992, as part of a general realignment of combat forces within the US Air Force, SAC was disestablished. Simultaneously, the Air Combat Command (ACC) was established, and most of SAC's assets, including the B-1B, were transferred to the new command.

In full operational service with the Air Combat Command, the B-1B Lancer is classified as a multi-role, long-range bomber, capable of flying intercontinental missions without refueling. It can perform a variety of missions, including that of a conventional weapons carrier for theater operations. It is the backbone of America's bombardment fleet. Working along side Boeing's 38-year old B-52H Stratofortress (the first B-52H made its first flight on 10 July 1960) and Northrop

Grumman's new B-2A Spirit (the first B-2A made its first flight on 17 July 1989), the Lancer's service duties include:

1. During a nuclear exchange, a single B-1B can carry and deliver as many as 24 B61 or B83 free-fall nuclear bombs; 16 AGM-129A advanced cruise missiles (ACM); or 24 AGM-86B/C air-launched cruise missiles (ALCM); or any combination of thereof. For example, a single B-1B can deliver eight B61s or B83s, eight AGM-129As, and eight AGM-86Bs, all on a single mission.

2. In a conventional role, a single B-1B can deliver up to 84 Mk 82 500-pound bombs; 30 CBU-87/89/97 cluster bomb units (CBU); 84 Mk 62 mines; the upcoming joint air-to-surface standoff missile (JASSM); the upcoming joint direct attack munitions (JDAM); or the AGM-154A joint standoff weapon (JSOW).

3. The original B-1A was envisioned as being armed with up to 24 Boeing AGM-69A SRAMs—eight in each of the three weapons bays on rotary launchers. Later, as the B-1A was being developed into the B-1B, Boeing developed the AGM-131A SRAM II for use on the B-1B, but it was canceled before production began. The original AGM-69A has also been removed from service due to concerns over cracks developing in its rocket motor.

Special Accomplishments

In 1976 the Air Force, Rockwell, and the B-1 industry team was awarded the Robert J. Collier Trophy. Presented annually by the National Aeronautic Association (NAA), this prestigious trophy recognizes the "greatest achievement in aeronautics or astronautics in America, with

Although not particularly attractive, the dark camouflage used on the B-1B serves its purpose well when the aircraft is flying at low levels. (Boeing North American)

Almost a blur, a Lancer penetrates the skies over Edwards during a low-level high-speed pass. Capable of penetrating enemy air space at very high subsonic speed only 200 feet off the deck, the B-1B can also bomb from altitudes exceeding 50,000 feet at a top speed of about Mach 1.25. Furthermore, the aircraft has a wide-ranging arsenal of weapons ranging from nuclear bombs to sea mines—and can off load them all with deadly precision. Note the trio of weapons bay doors outlined in white. (Boeing North American)

Afterburners lit on its four 30,780 pounds-thrust F-101-GE-102 turbofan engines, a B-1B uses its available 123,120 pounds-thrust to make a maximum performance takeoff at Edwards AFB in mid-1995. This ninth production Lancer (84-0049), is still used for weapons tests by the 419th Flight Logistics Test Squadron at Edwards, and, in late-1994, was named Thunder From The Sky *using Mike Machat's nose art.* (Air Force Flight Test Center History Office)

B-1B number nine makes a pre-dawn takeoff at Edwards AFB in mid-1986 with its four afterburners ablaze. During this particular test mission it successfully fired an inert Boeing SRAM II that, at the time, was nearing production status. However, development of the SRAM II terminated shortly thereafter. Even though a single B-1B was able to carry and deliver up to 24 of the original AGM-69A SRAMs, it will never do so since the AGM-69A SRAM was removed from service in 1994. (Boeing North American)

respect to improving the performance, efficiency, and safety of air or space vehicles, the value of which has been thoroughly demonstrated by actual use during the preceding year."

In 1987 the Mackay Trophy was awarded to Detachment 15, USAF Plant Representative Office, and B-1B System Program Office (SPO) for 72 record B-1B flights. The Mackay Trophy, presented by the NAA, recognizes "the most meritorious flight of the year" by a USAF member, members, or organization. On 4 October 1989, a crew from the 96th Bombardment Wing (now 7th BW), made an emergency landing at

Edwards AFB in a B-1B (85-0070) without its nose landing gear lowered, and with minimal damage. For this accomplishment, the NAA presented its crew with the 1989 Mackay Trophy.

Around the World Flight

At 5:25 p.m. on 11 August 1993, two 28th Bomb Wing B-1Bs (86-0093 – *Global Power*; and 86-0104 – *American Flyer*) from Ellsworth AFB, South Dakota, took off for operation Global Enterprise. This was an ACC exercise to train air crews for long-distance power-projection missions. The first leg of the flight lasted 24.5 hours (*Global Power*) and 24.3 hours (*American Flyer*) while the second leg logged 23.3 hours (*Global Power*) and 23.4 hours (*American Flyer*). The mission ended back at Ellsworth at 7:25 AM on 14 August 1993.

Respectively, these two B-1B aircraft were manned by Captains Keith Cunningham (instructor pilot), Todd Westhauser (aircraft commander), Tim Eichorn (offensive systems operator), and Paul Roberts (defensive systems operator); and Tony Smith (IP), Jeff Mikesell (AC), Gary Sjurset (OSO), and Pete Hughes (DSO). During the mission, both aircraft demonstrated their conventional weapons delivery capabilities at ranges in the Netherlands and in the northern Pacific Ocean off the western coast of Canada.

The Lancers flew from Ellsworth to Europe and across the Mediterranean Sea and Red Sea, skirted the Arabian Peninsula, and landed at a staging base in southwest Asia (an island in the Indian Ocean). After changing crews, the B-1Bs flew from southwest Asia to Japan, then over the Aleutian Islands in Alaska before returning to South Dakota. It was the first time that B-1Bs had circumnavigated the globe. Respectively, the second crews on *Global Power* and *American Flyer* were captains Jeffrey Kubiak (IP), Andy Thomson (AC), Doug Miles (OSO), and Bob Distaolo (DSO); and Chuck Petty (IP), Vic Wade (AC), Pete Hobday (OSO), and Marty Case (DSO).

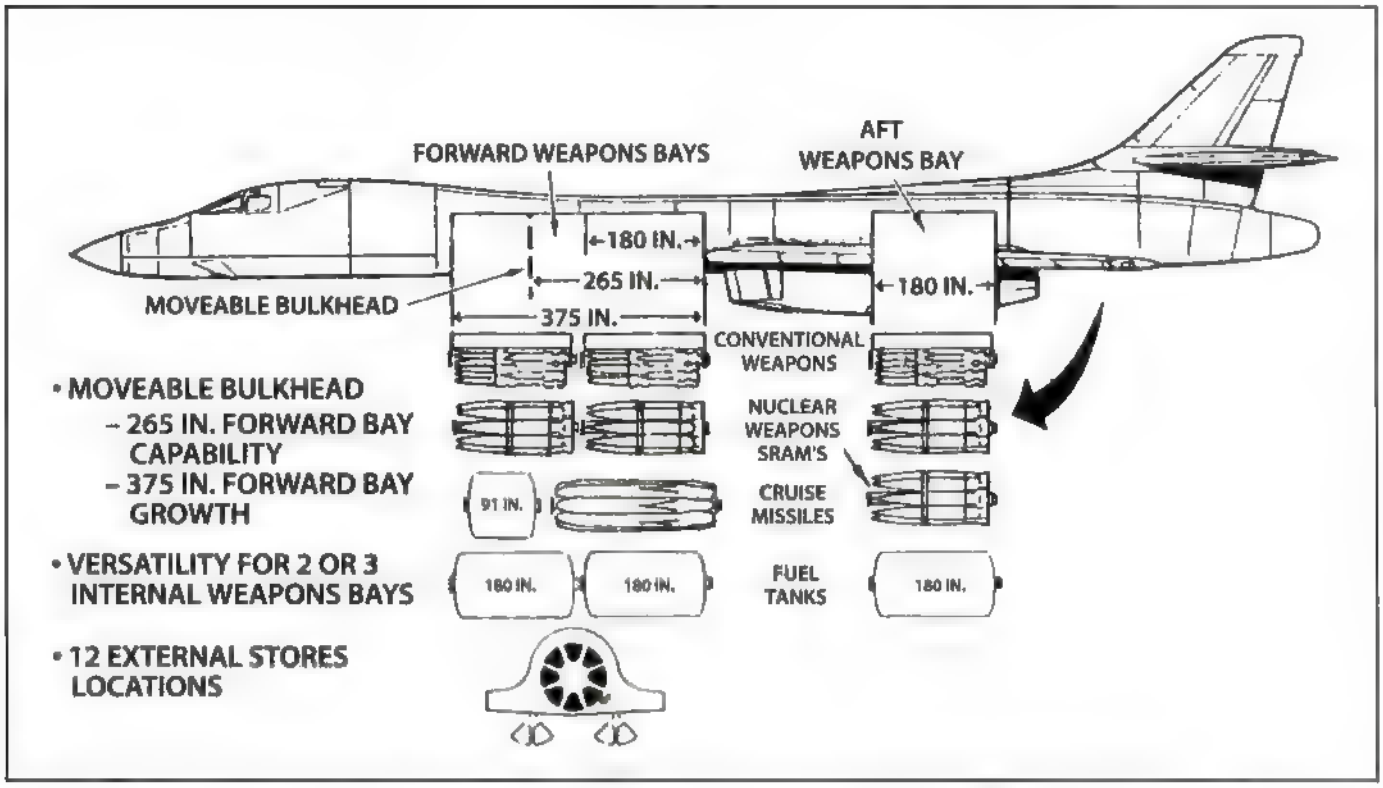
Earlier in mid-1992, during a Red Flag exercise at Nellis AFB, Nevada, the 319th BW, 46th BS, from Grand Forks AFB, North Dakota, used several of their B-1Bs to demonstrate a number of new tactics. With "considerable success," some of these tactics included:

1. To confuse target defenders about the attack force's mass, several B-1Bs wove back and forth, crossing each other's flight paths while

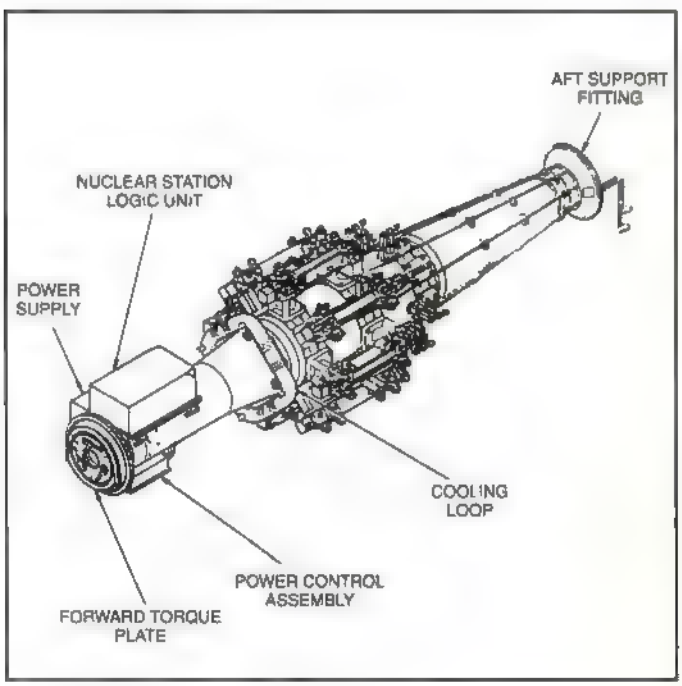
B-1 WORLD TIME-TO-CLIMB RECORDS

Altitude	A/B/C Weight Categories	Time-to-Climb
10,000 feet	A=170,000-220,000 pounds	1 min, 13 sec
10,000 feet	B=220,000-330,000 pounds	1 min, 19 sec
10,000 feet	C=330,000-plus pounds	1 min, 59 sec
20,000 feet	A	1 min, 42 sec
20,000 feet	B	1 min, 55 sec
20,000 feet	C	2 min, 39 sec
30,000 feet	A	2 min, 11 sec
30,000 feet	B	2 min, 23 sec
30,000 feet	C	3 min, 47 sec
40,000 feet	A	5 min, 01 sec
40,000 feet	B	6 min, 09 sec
40,000 feet	C	9 min, 42 sec

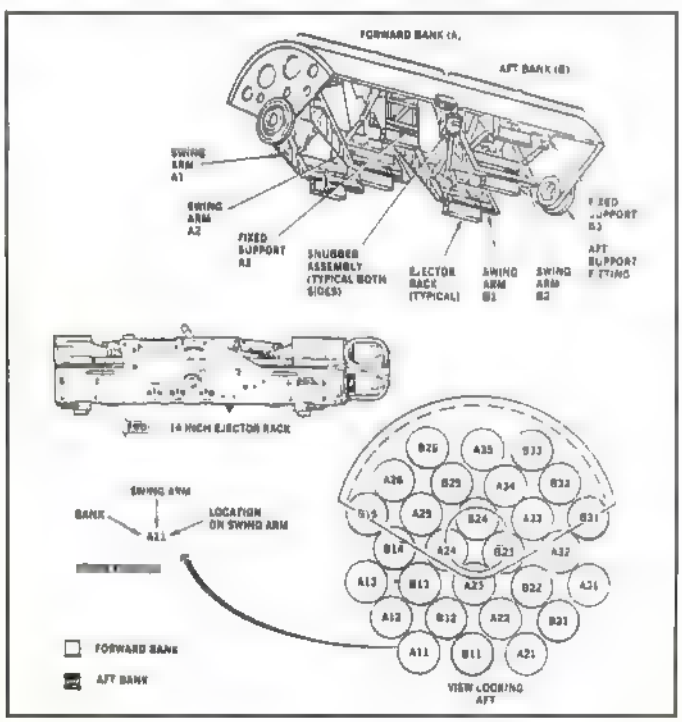
The B-1B has set World Time-to-Climb records to four different altitudes. Since the aircraft used on each of these flights weighed more than 330,000 pounds, the B-1 simultaneously set records in three separate weight categories.



This inboard profile of the B-1B's three weapons bays shows the versatility of the aircraft's mission capabilities. For example, internally, it can carry four advanced cruise missiles (ACM); in addition, externally, it can carry another 12 ACMs. (US Air Force)

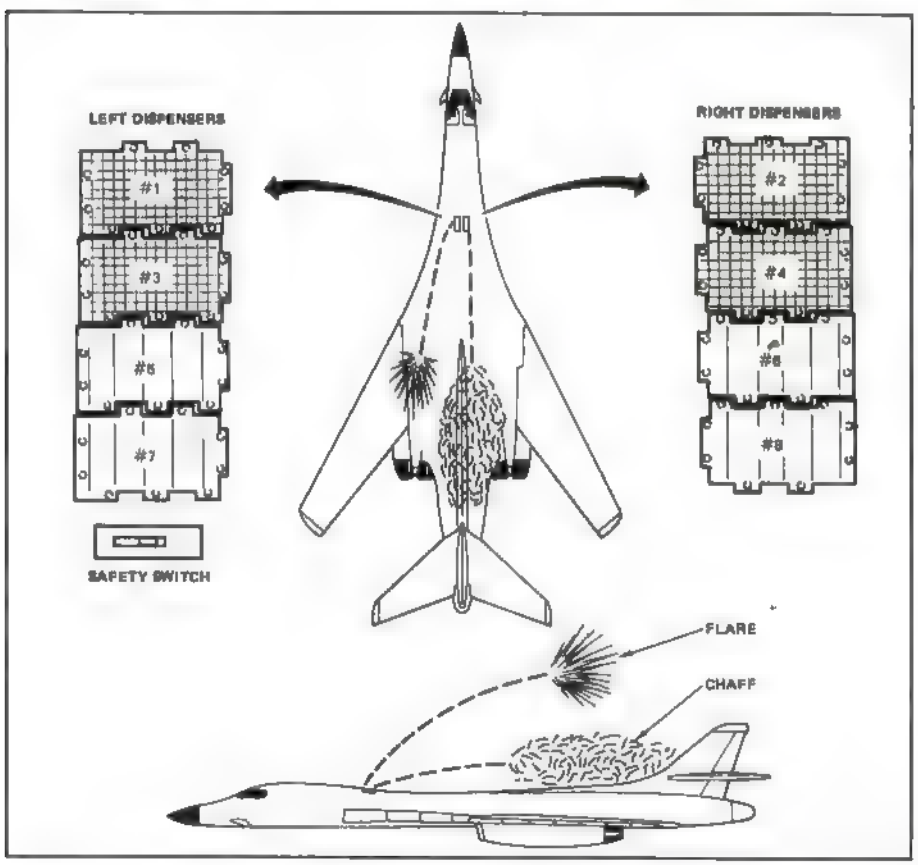


The multi-purpose launcher is used for the carriage of either B61 or B83 nuclear bombs ("special weapons," as the Air Force calls them); eight per launcher. (US Air Force)



The B-1B Lancer uses several different types of weapons launchers to perform its multitude of combat missions. One of these is the conventional weapons module for the carriage of free-fall gravity bombs. (US Air Force)

When its nose landing gear refused to lower on 4 October 1989, this B-1B (85-0070; Excalibur*) of the 96th BW at Dyess AFB, Texas, was forced to make an emergency landing on lakebed runway 33 at Edwards AFB. The nationally televised event was largely uneventful since its pilot—Capt. Jeffery K. Beene—literally greased it onto Rogers Dry Lake with very slight damage. The aircraft was later repaired and returned to operational status.* (Air Force Flight Test Center History Office)



Due to the low-level the B-1B typically operates at, chaff and flares are ejected upward (which also keeps them out of the engines). (US Air Force)

emitting a salvo of electronic countermeasures.

2. After striking with a unified package of F-15Es, F-16Cs, and B-1Bs, and after streaking through the target area in accurately timed waves, the aircraft departed—all except the F-15E Strike Eagles. They climbed about 2,000 feet, reversed course, and caught the Red Air fighters totally off guard.

3. Several B-1Bs, flying line abreast about one nautical mile apart, hit multiple targets on a single attack.

4. A wave of F-16C fighters were sent over a target to "clear the area and create a diversion," followed by a single B-1B to actually bomb the target. The B-1B pilot said. "...then we egressed the area at Mach 0.95, so none of the Red Air fighters could catch us."

The Red Flag exercise discussed above was held more than six years ago and demonstrated that the B-1B Lancer, originally created as a dedicated strategic bombardment aircraft, can be used effectively as a tactical bombardment aircraft.

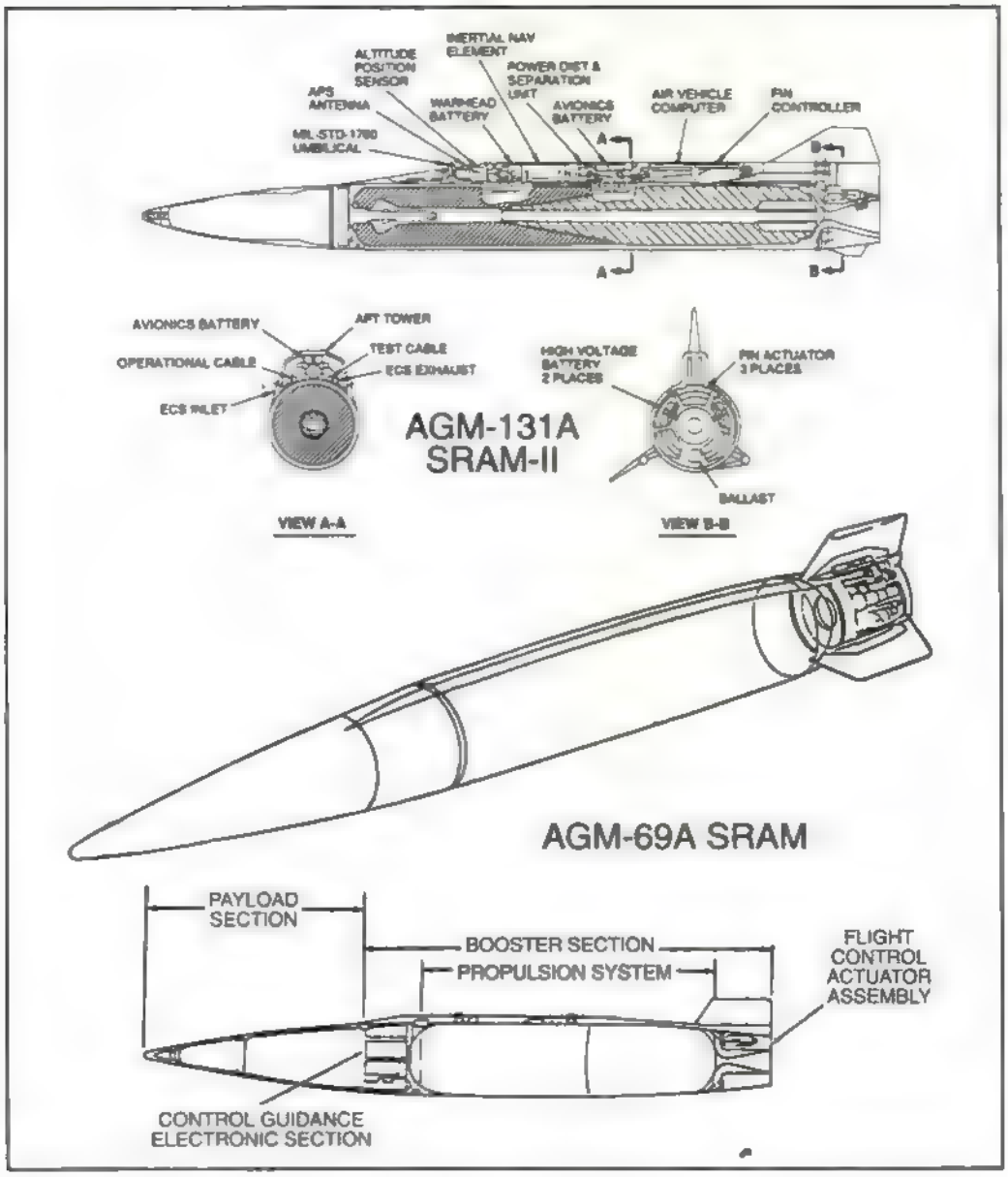
In 1994, by direction of Congress, a six-month-long operational readiness assessment (ORA) was held where the B-1B was required to demonstrate its ability to achieve a 75% mission capable rate. The assessment was conducted by the 28th BW at Ellsworth AFB, South Dakota, and the ORA met or exceeded all requirements.

As a multi-role bomber, the B-1B was originally developed to function as an extremely flexible asset in the strategic Single Integrated Operational Plan (SIOP). Although no B-1Bs are currently maintain nuclear alert, the aircraft is capable of standing alert for up to 30 days with a minimum of maintenance, and can be airborne within minutes of a scramble order. The aircraft can be operated from remote locations with a minimum of support.

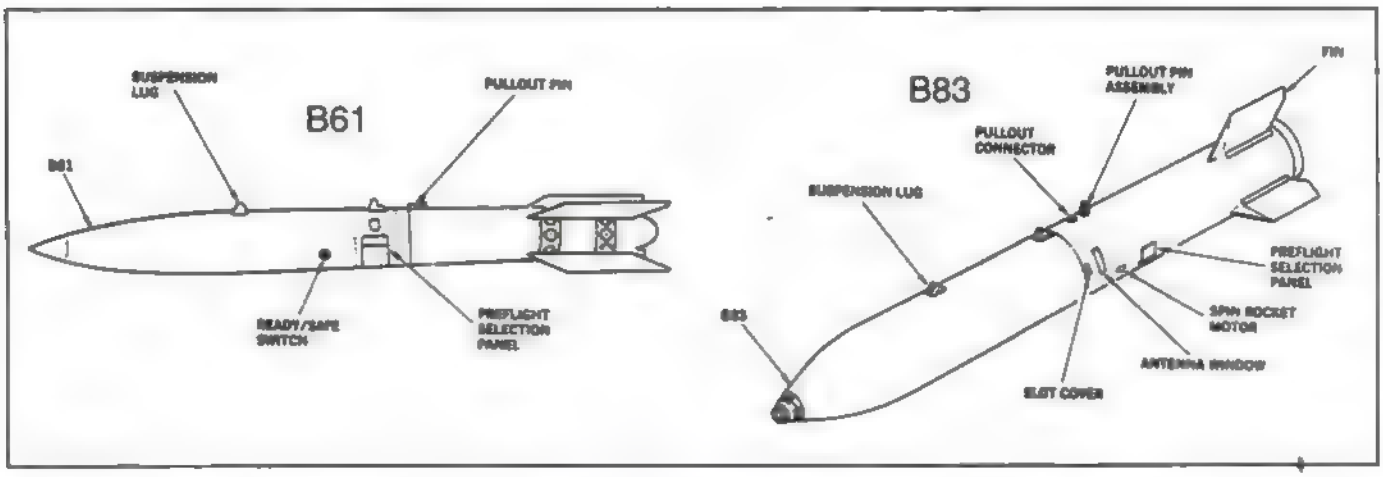
The B-1B is fully able to operate in a nuclear weapons environment. This means that it can perform its mission while withstanding overpressure, thermal flash and radiation, electromagnetic pulse, and transient radiation effects.

Reportedly having a 30-year service life, the oldest B-1B will reach its 30th year in the year 2015, and the youngest in 2018. But if the longevity of the B-52 is any indication, at least some B-1Bs will be flying operational sorties through the year 2020.

Inverted while it automatically dumps fuel to keep its center of gravity (c.g.) appropriate for its flying envelope, a B-1B soars over the mountainous terrain of south central California near Death Valley in early-1986. It appears to be an extreme maneuver for an aircraft which has a gross weight of 477,000 pounds fully loaded, however, it would never perform such a maneuver at that weight. (Boeing North American)

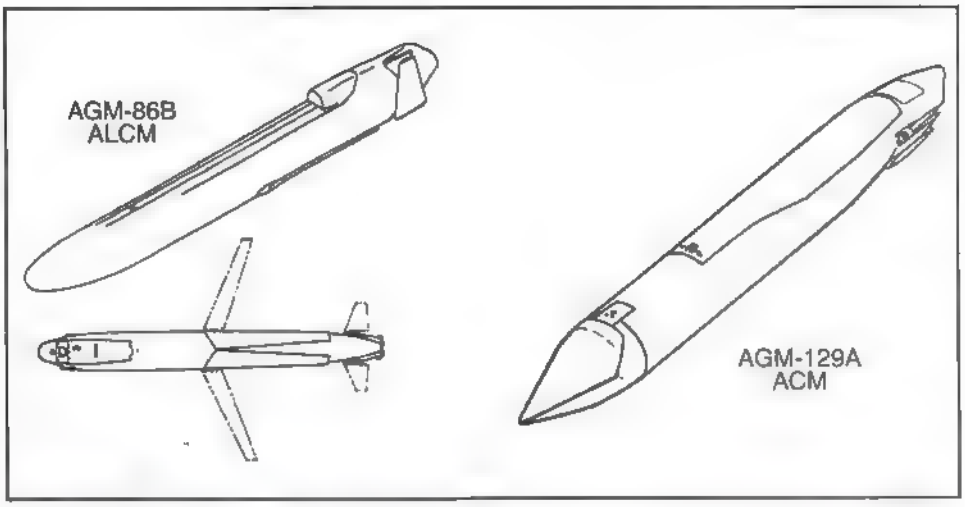


The B-1B can carry eight Boeing AGM-69A Short-Range Attack Missiles (SRAM) in each of its three weapons bays; each having a 170 kiloton nuclear warhead. Another version of Boeing's SRAM was the improved, higher yield AGM-131A SRAM II. Though testing of the later was successful, the Bush administration canceled the SRAM II program in 1991. (US Air Force)

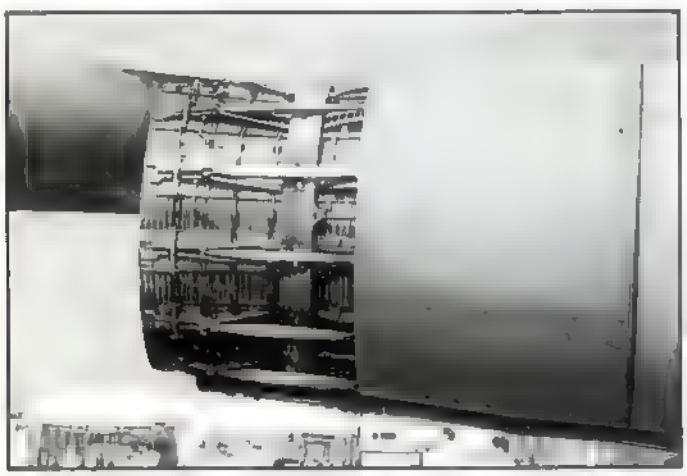


The two main nuclear bombs carried by the B-1B are the 10-500-kiloton B61 thermonuclear device and the one to 2-megaton B83 shown at right. (US Air Force)

The B-1B can carry two different types of dedicated air-launched cruise missiles or ALCMs. These are the AGM-86B ALCM and the AGM-129A Advanced Cruise Missile (ACM). Another version of the AGM-86, the conventionally armed AGM-86C, is known as the Conventional Air-Launched Cruise Missile (CALCM). The Lancer, however, has not been fully optimized to carry the AGM-129A. (US Air Force)



Open weapon bays reveal an extra fuel tank. All three of the B-1B's weapons bays can carry fuel tanks, and the forward bay can be configured with either of two different size tanks. (Chris M. Reed)



Like the F-15, the B-1 is loosing the "turkey feathers" from its engine nozzle. Although they provide a minor aerodynamic benefit, they are expensive to procure and hard to maintain. (Chris M. Reed)

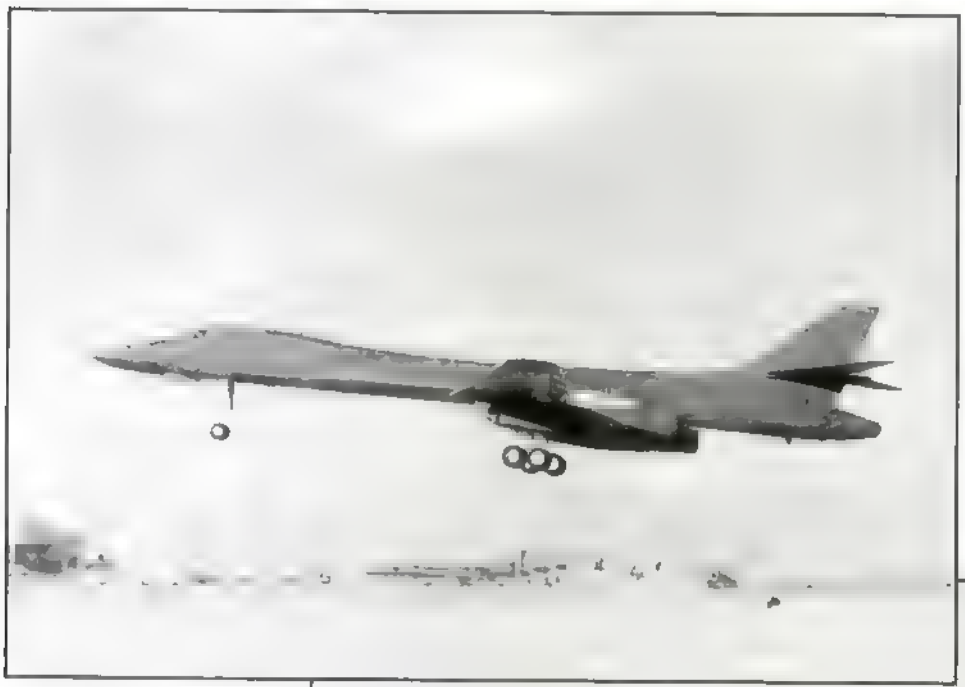
The second production B-1B Lancer is shown landing after its 4 May 1985 first flight from Palmdale to Edwards AFB. It was later delivered to the 96th BW (Heavy) (now 7th BW), 337th Bomb Squadron. Structurally, the Lancer has been strengthened to increase its gross take off weight from 395,000 to 477,000 pounds. (Boeing North American)

As it banks to the left, a B-1B begins its descent for a landing at Palmdale after a manufacturer's test flight prior to delivery. Housed within its conically-shaped tail cone is, amongst other items, the Radio Frequency Surveillance/Electronic Countermeasures System components of the Eaton AN/ALQ-161A DAS. The B-1B's tail cone shape was modified from the B-1A's to reduce boat tail drag. (Boeing North American)

Almost unbelievably, the B-1B can carry a much heavier payload than the B-52 it has mostly replaced: 125,000 versus 50,000 pounds. (Boeing North American)

Parked alongside a KC-135 Stratotanker, seven brand new B-1Bs grace the Palmdale flight line on 18 August 1986. The arrangement of the Lancer's pitot heads and low altitude ride control system fins is noteworthy. (Boeing North American)

Unofficially named Centurion *at the time, the 100th and last B-1B (later named* Lancer*) departs Palmdale on 4 April 1988 for its first flight. Two months ahead of schedule, the aircraft was delivered to the Strategic Air Command in a ceremony on 30 April 1988. It arrived at McConnell AFB, Kansas, on 2 May to begin service with the 384th BW.* (Boeing North American)



A late production B-1B lifts off from Palmdale in late-1987 to enter into its manufacturer's flight test phase. In just four years, between mid-1984 and mid-1988, all 100 Lancers were delivered to the Air Force under budget and ahead of schedule. Total program cost was reported to be $20.5 billion; thus, each B-1B had a sticker price of $205 million. Not at all bad when one considers the price of a single B-2A is about $2 billion! (Boeing North American)

Afterburners lit, B-1B number five (83-0068) departs Palmdale on its delivery flight to Dyess AFB in early-1986—it was delivered to the 96th Bomb Wing (now 7th BW) and received the name Spuds*, after Budweiser Beer's mascot Spuds McKenzie.* (Boeing North American

CURRENT EVENTS

REPLACING THE B-52G, SUPPLEMENTING THE B-52H, AND THE B-2A

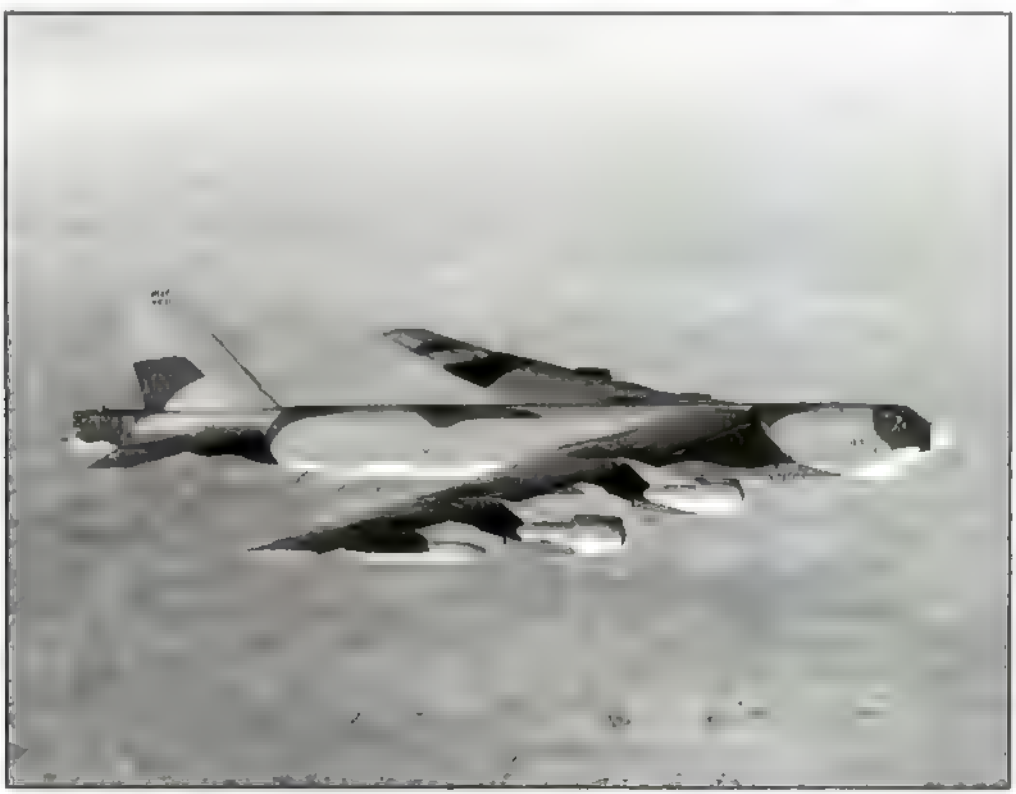
All the B-1Bs were operational by mid-1998, finally allowing the Air Force to retire its fleet of Boeing B-52G Stratofortress aircraft, leaving about 90 B-52Hs in service until at least the year 2003. And considering the on again, off again, Northrop B-2A Spirit production program, the B-1B does indeed supplement the bantam fleet of some 20 operational stealth bombers. The B-1B serves in operational ACC squadrons, as well as in some Air National Guard squadrons (becoming, in the process, the first front-line bomber to serve with the ANG).

America's once mighty fleets of different types of jet-powered strategic bombardment aircraft (B-45s, B-47s, B-52s [through the G model], B-58s, and FB-111As) has consistently spiraled downward to some 200 bombers of all types, with nothing new on the horizon.

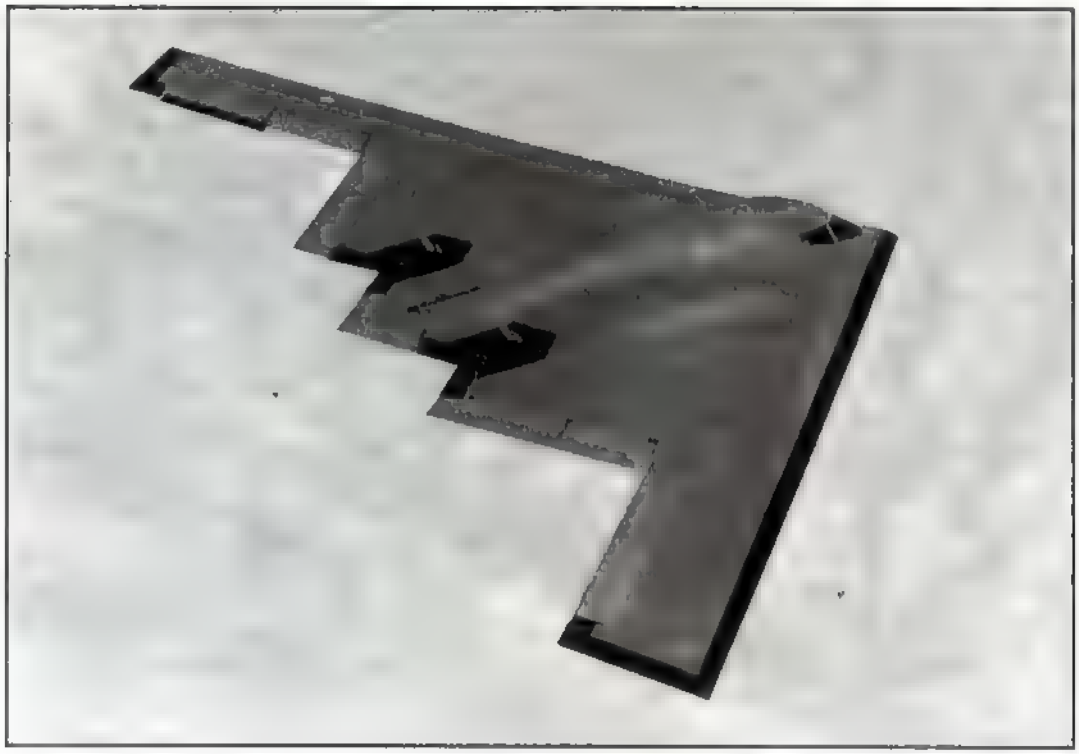
Has the manned bomber become a thing of the past? While it is true that the B-2A, B-52H, and the B-1B are very capable bombers, some special-purpose fighter aircraft (such as the F-117A Nighthawk, F-15E Strike Eagle, F-16C/D Fighting Falcon, and the F/A-18E/F Super Hornet) can carry and deliver some of the same weapons dispensed by the bombers. But they neither have unrefueled range nor heavy payload capabilities to perform as strategic bombers.

Exercise Brilliant Foil

During 28 May to 3 July 1997, a record number of B-1Bs were deployed to the United Kingdom where they demonstrated their capabilities in three North Atlantic Treaty Organization (NATO) exercises.



The Boeing B-52H Stratofortress, first flown on 10 July 1960, was originally produced to serve as a standoff missile platform bomber under Weapon System 101. It was intended to carry four (two under either wing) Douglas GAM-87 Skybolt Air-Launched Ballistic Missiles (ALBM) which was canceled in December 1962. Instead the B-52H carried two (one under either wing) North American AGM-28 (formerly GAM-77) Hound Dog supersonic cruise missiles. Four McDonnell ADM-20 (ex GAM-72) Quail air-launched decoy missiles were carried in the rear of the bomb bay. Today's B-52H is armed with eight nuclear free-fall bombs carried internally, 12 Boeing AGM-86B/C (B=nuclear, C=conventional) Air-Launched Cruise Missiles (ALCM) or AGM-129A (nuclear) Advanced Cruise Missiles (ACM), and as many as eight more ALCMs or gravity bombs, internally. It can also carry up to eight Boeing AGM-84A Harpoon conventional missiles on underwing pylons, four Rafael AGM-142A Raptor conventional missiles, and most anything else in the ordnance inventory. (Boeing Military Airplane Company)



The Northrop Grumman B-2A Spirit, first flown on 17 July 1989, is a dedicated stealth bomber that can deliver up to 20 B61 bombs, 16 B83 bombs, or a combination of both. Conventionally, the Spirit can carry 80 Mk 82 500-pound bombs or precision-guided munitions (PGM) such as the laser-guided Texas Instruments GBU-27 2,000-pound smart bombs. These weapons are carried internally in side-by-side weapons bays. Due to the limited number produced, the B-2A is far less available to Air Force planners than either the B-52H or the B-1B. As of this writing, only 21 Spirits have been manufactured. (Northrop Grumman)

Aircraft from two B-1B bomb wings, the 7th BW from Dyess AFB, and the 28th BW from Ellsworth AFB, were temporarily merged at a forward operating location. The Royal Air Force (RAF) base at Fairford was host to the two Lancer units, known jointly as the 7th Expeditionary Bomb Group (EBG).

The 7th EBG began a global power demonstration in Exercise Brilliant Foil as it deployed four B-1Bs from Dyess AFB on 28 May 1997. The Lancers flew non-stop from Abilene to France, then completed simulated low-altitude strikes. Two of the B-1Bs then completed a 24-hour mission by flying straight back to Dyess, while the other two Lancers recovered at RAF Fairford to remain for the month-long deployment. Rounding out the 10-aircraft deployment, during the following week, eight additional B-1Bs arrived at RAF Fairford.

On 9 June 1997, Exercise Brilliant Foil became Exercise Central Enterprise. This was a two-week ground war exercise in Europe which incorporated the B-1B into a coalition force with other NATO strengths. "We exercised various aircraft together, incorporating various languages and various procedures from air forces of different countries," said Colonel Tony Przbyslawski, 7th EBG commander.

The 7th EBG also participated in the

B-1B Bomb Wings and Squadrons as of 1 August 1998

Bomb Wing	Bomb Squadron
7th Bomb Wing (ACC)	9th Bomb Squadron
	28th Combat Crew Training Squadron
28th Bomb Wing (ACC)	37th Bomb Squadron
	77th Bomb Squadron
116th Bomb Wing (ANG)	128th Bomb Squadron
184th Bomb Wing (ANG)	127th Bomb Squadron

NATO naval exercise BALTOPS on 23 June 1997, infusing its Lancers into a war-at-sea scenario. "We proved that the B-1B can lay mines at sea. And we learned a great deal more about interacting with the US Navy," Colonel Przbyslawski said.

But the biggest benefit of the deployment seemed to be creating the "footprint" of the B-1B bomber, and creating a tiger team to establish "Bone (B-1B nickname) Standards." "A footprint is establishing what it takes to get a weapon system into a theater and sustain it there for a period of time. We have created that footprint for the B-1B here," said Przbyslawski. "We also significantly shrunk the amount of airlift required to support the B-1B from what was [originally] planned."

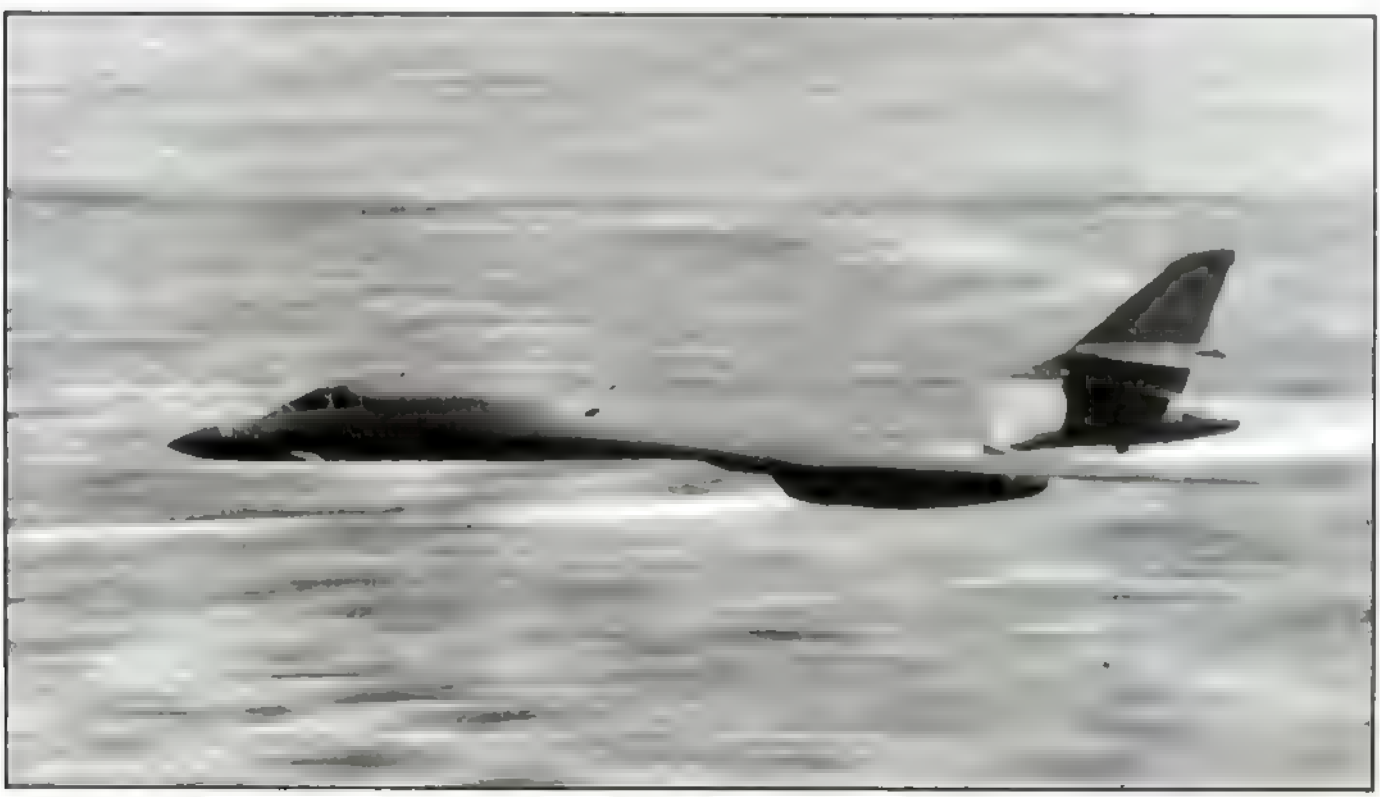
Operation Desert Shield

At 2:00 a.m. local time on 2 August 1990, Iraq's Saddam Hussein sent 100,000 of his troops into Kuwait and, in a very short time, took complete control of that lightly defended nation. The world was appalled. Under Operation Desert Shield, the precursor to Operation Desert Storm, the United States and many other nations joined together to form a coalition to deal with the situation. By late-1990, the coalition force was in place and ready to retaliate against Iraq.

For its part in the military buildup, the United States sent over numerous attack and fighter aircraft. These included A-6 Intruders, AV-8 Harriers A-10 Warthogs, F-14 Tomcats, F-15 Eagles, F-15E Strike Eagles, F-16 Fighting Falcons, F/A-18 Hornets, F-111 Aardvarks, and even F-117 "Stealth" Nighthawks, but no heavy bombers. Although the B-52 Stratofortress would be used if war erupted, they would fly their missions from the continental United States using aerial refueling as necessary.

Of course SAC wanted to use its B-1B in what was now called Operation Desert Storm. But this was not to be since, at the time, the fleet of Lancers were operational as nuclear-only bombardment aircraft. And the use of nuclear weapons was out of the question. So the B-1Bs did not participate in Operation Desert Storm.

That handicap no longer exists. Using most of the weapons now carried by B-1Bs, the participating



This is B-1B number one during its 37th test flight. It was used extensively for aerodynamics and weapons release tests. Named Leader of the Fleet, *by 28 April 1988 the aircraft had logged 617 flying hours during 138 test flights. It was finally delivered to the 28th BW at Ellsworth AFB, South Dakota, on 2 August 1988, but was removed from flight status in late 1988 and was subsequently used for weapons loading practice.* (Boeing North American)

coalition aircraft decimated Saddam's desire to fight. And in record time. At this writing, if Iraq or any other nation rears up, a single conventionally armed B-1B, flying from its base in the United States, can accurately deliver up to 133,800 pounds of weapons upon it. This includes 75,000 pounds of ordnance carried internally and 58,800 pounds carried externally.

Operation Desert Thunder

Operation Desert Thunder was the coalition's response to Saddam's continued acts of non-compliance with United Nations resolutions and began in early-1998. This time the B-1B was ready, and the Air Force wasted little time deploying several aircraft to the Persian Gulf.

In late-1997, even before Operation Desert Thunder began, two B-1Bs from the 28th Bomb Wing, 37th Bomb Squadron, at Ellsworth, had deployed to Bahrain. They were deployed for possible use against Iraq if it persisted with its, "You can inspect this, but you cannot inspect that," turbulence with the United Nations (UN) inspection team.

One of the original two B-1Bs that deployed was scheduled for depot maintenance and returned to the United States in February 1998. On 15 February 1998, two additional Lancers departed Ellsworth for Bahrain to participate in Desert Thunder if required. Thus, at this writing, there are three B-1Bs in Bahrain.

Single Integrated Operational Plan

The B-1B is part of the Single Integrated Operational Plan (SIOP), which allocates strategic assets to specific targets during a nuclear war. An example would be a military aircraft factory in a certain city in a certain country. The B-1B SIOP penetration mission profile consists of four phases: takeoff and cruise; penetration and weapons delivery; withdrawal; and recovery.

Takeoff for SIOP missions occur from continental US bases. Mission length is variable depending on the target, and is accomplished at best cruise altitude with in-flight refueling as required. At penetration, the Lancer descends to 200 feet above

Properly configured, the B-1B can carry just about any available US ordnance. Here in a rare pose, a B-1B is partially surrounded by some of the weapons it can carry. Shown left-to-right are conventional Mk 82 500-pound free-fall gravity bombs, a GBU-27 2,000-pound smart bomb, a Texas Instruments AGM-142A Joint Stand-Off Weapon (JSOW), a Boeing North American GBU-15 2,000-pound glide bomb, a GBU-28 2,000-pound smart bomb, and a cluster bomb, mine, and so on. (US Air Force)

A B-1B unloads a stick of 36 1,000-pound Tactical Munition Dispensers (TMD) on the Edwards AFB bomb range in early-1987. TDMs break apart as they fall, with each piece exploding on contact with the ground—preferably on an enemy's runway, making it inoperable. In this photograph, the bright light shows one of the cluster bombs breaking up by way of a timed detonation created by an onboard explosive charge. (Air Force Flight Test Center History Office)

ground level and accelerates to a minimum speed of Mach 0.85. Withdrawal is accomplished at the same altitude at a minimum of Mach 0.55. Recovery for a SIOP mission generally occurs at a non-US base and may include a climb to cruise altitude as necessary.

The exact penetration distance flown varies with the specific category for the B-1B mission. Mission flexibility is afforded with the carriage of internal fuel in the weapon bays through the installation of non-jettisonable, cylindrical fuel tanks. For the longest missions, two bays may be loaded with fuel and only one bay with weapons.

The SIOP penetration mission is one of five Specification Missions for the B-1B used as a design reference. The other four are Shoot-Pen, Standoff, World Wide Power Phase I, and World Wide Power Phase II. The penetration mission is most commonly used for mission analysis at this writing.

B-1B Mission Range

The B-1B has been evaluated for the performance of several types of missions. These missions are described in the accompanying table to illustrate the mission flexibility and performance of the Lancer. The SIOP Specification Mis-

sion, a primary strategic mission of the B-1B, is included as reference. The existing fleet of more than 90 B-1Bs is capable of meeting the range and payload requirements for the SIOP penetration mission.

Further increases in range can be achieved through the addition of external fuel tanks or through decreasing wing sweep during the penetration phases of a mission. While these enhancements have been studied in some detail, there are currently no plans for implementation.

The B-1B's low-level (terrain following) range at Mach 0.85 with 67.5° wing sweep back is 3,016 nautical miles; at Mach 0.55 with 67.5° sweep, it is 3,905 nautical miles. If enhanced, the Lancer's range without external fuel tanks, at Mach 0.45 to Mach 0.85 with 35-67.5° sweep, increases to 4,200 nautical miles; and with six 1,000 US gallon external fuel tanks to 4,670 nautical miles.

Automatic Terrain Following/Terrain Avoidance

Since the B-1B is not a stealth aircraft, its survivability when penetrating enemy defenses will depend in large part on its ability to fly low to avoid radar detection. Therefore, the Lancer is equipped with the Terrain Following (TER FLW) and Terrain Avoidance (TER AVD) radar modes. The APN-224 radar altimeter is accurate from zero to 5,000 feet above land and water.

The Lancer is optimized to fly in an Automatic Terrain Following (ATF) mode at 200 feet above ground level (AGL), in all weather, and at night. The B-1B incorporates several ATF modes. One mode, known as "hard ride," closely follows terrain contours and is intended for use in high threat environments. Another mode called "soft ride" does not approximate the contour of the ground as closely, and provides a smoother flying experience. The softer ride is appreciated by the flight crew, and also by the mechanics on the ground since it is less destructive to aircraft systems.

Originally, the ATF mode produced numerous false fly-up (increase altitude) commands during initial use by operational B-1B pilots. As a result, the Air Force suspended ATF training until software modifications were made and tested. After the software was successfully modified, low-level training resumed. It should be noted that although training was suspended, the B-1B remained fully mission capable, and would have used the ATF mode during combat missions if necessary.

At this writing, the current ATF hardware with block 4.5 software is a fully functional and tested system which meets the ACC mission requirement for both "hard" and "soft" rides. And B-1B pilots are routinely using the ATF system to train for combat missions. The aircraft can follow the nap of the earth, through canyons, gullies and so on, and over water, without the need of crew intervention.

Build More B-1Bs?

Interestingly, during peak production of the B-1B in the mid-1980s, a total of about 167,000 production tools were being used by Rockwell International (now Boeing North

Comparison of Mission Ranges

Mission	Profile	Weapons	Tanker	Range
Spec SIOP	Hi-Lo-Hi	24 SRAMs	KC-135A	5,903 nm
			KC-135R	6,360 nm
			KC-10A	7,358 nm
Conventional	Hi-Lo-Hi	56 Mk82s	KC-135R	8,400 nm
			KC-10A	9,466 nm
ACM Standoff	Hi -		None	4,425 nm
			KC-135R	5,430 nm*
Penetration	Hi-Lo-Lo		KC-10A	5,963 nm*
			2 x KC-135R	7,220 nm*

** Includes 3,016 nm at 200 feet AGL and Mach 0.85*

A B-1B, center weapons bay open, carries six externally-mounted weapon pods. Each pod houses two AGM-86B/C ALCMs or AGM-129A ACMs. An extremely lethal weapons array when one considers that as many as 24 B61 or B83 nuclear bombs can also be carried internally. (US Air Force)

Shown here attached to a rotary launcher are four Boeing AGM-131A SRAM II short-range attack missiles that were slated for use by the B-1B. Due to a reduction in the arms race after the so-called Cold War ended, the SRAM II was canceled. (Boeing)

American) and its suppliers. When the last production B-1B was delivered in May 1988, a carefully planned procedure was implemented. This plan provided for:

Storage of all critical tooling deemed essential for after-production needs, including battle damage repair, structural modifications required by changing mission needs, and spares.

Keeping most expensive tooling and only discarding tooling that can be replaced quickly and inexpensively.

Retaining long lead time tooling that would require a substantial period of time to rebuild.

A portion of the non-dimensional special tooling was sent to operational and maintenance bases while the balance was scrapped. This category included such items as work platforms, ramps around aircraft and large cargo containers for shipping major subassemblies.

As a result of this plan, approximately 57% of peak production tooling was retained in government storage and at the manufacturer and suppliers. However, the retained tooling represents 80% of the total value (cost) of all B-1B tooling and includes all the long-lead time items. Additional tooling that may be required would only represent 20% of overall tooling value, and this supplemental tooling required could also be generated quickly. A total of 96,000 tools are currently available with 66,000 in government storage and 30,000 at the manufacturer and suppliers.

New Weapons

To meet changing mission require-

As the sun begins to set, during its 101st flight at Edwards AFB, B-1A number four gets a drink of JP-4 fuel from a Boeing KC-135 Stratotanker. Without inflight refueling, the B-1B has a maximum range of about 6,475 nm (7,455 miles; 12,000 kilometers). (Boeing North American)

Here B-1B number 40 (85-0080) is static in the USAF's Anechoic Chamber at Edwards AFB. The B-1B was the first aircraft to be tested in the facility after it was built. (Boeing North American)

Like many high-value military aircraft, the B-1B is frequently guarded, especially when it is carrying live weapons. Note the markings surrounding the refueling receptacle on top of the forward fuselage. (US Air Force via Tony Landis)

Looking more like a fighter pilot than a bomber pilot (note the control stick between his legs), a B-1B Lancer driver is shown at work during a flight. B-1B pilots and copilots rave about the aircraft's exceptional maneuverability and agility. (US Air Force)

ments, the B-1B is being optimized to carry and deliver several new weapons. One such weapon, projected to be operational with the Lancer in February 1999, is the Boeing Joint Direct Attack Munition (JDAM). A single B-1B is to carry up to 24 JDAMs, eight in each of its three weapon bays on rotary launchers.

In a test of a JDAM launched from a B-1B (*Thunder From The Sky*) on 22 January 1998, the Lancer used its Global Positioning System/Inertial Navigation System (GPS/INS) to successfully hit a target. Then on 11 February 1998, while flying at Mach 0.85 and an altitude of 24,000 feet, the same B-1B dropped a JDAM that impacted within 22 feet of the center of its target.

The JDAM uses a Boeing-built guidance kit to convert existing unguided free-fall "iron" bombs such as the Mk 83 and BLU-110 1,000-pound class bombs, and Mk 84 and BLU-109 2,000-pound class bombs into

During a ceremony on 22 January 1988, the 100th and last B-1B, still unpainted, was rolled out of its Palmdale factor. (Boeing North American)

accurately-guided "smart" weapons. JDAMs can be dropped more than 15 miles from the target, with continuous updates from GPS satellites guiding them to their targets. When operational, a typical B-1B JDAM mission might involve targets such as hardened aircraft enclosures, bridges, command and control bunkers or military production factories.

Another new and "smart" weapon is the 2,000-pound class Joint Air-to-Surface Standoff Missile (JASSM). The JASSM will be a long-range "stealthy" weapon able to strike a target with extreme accuracy.

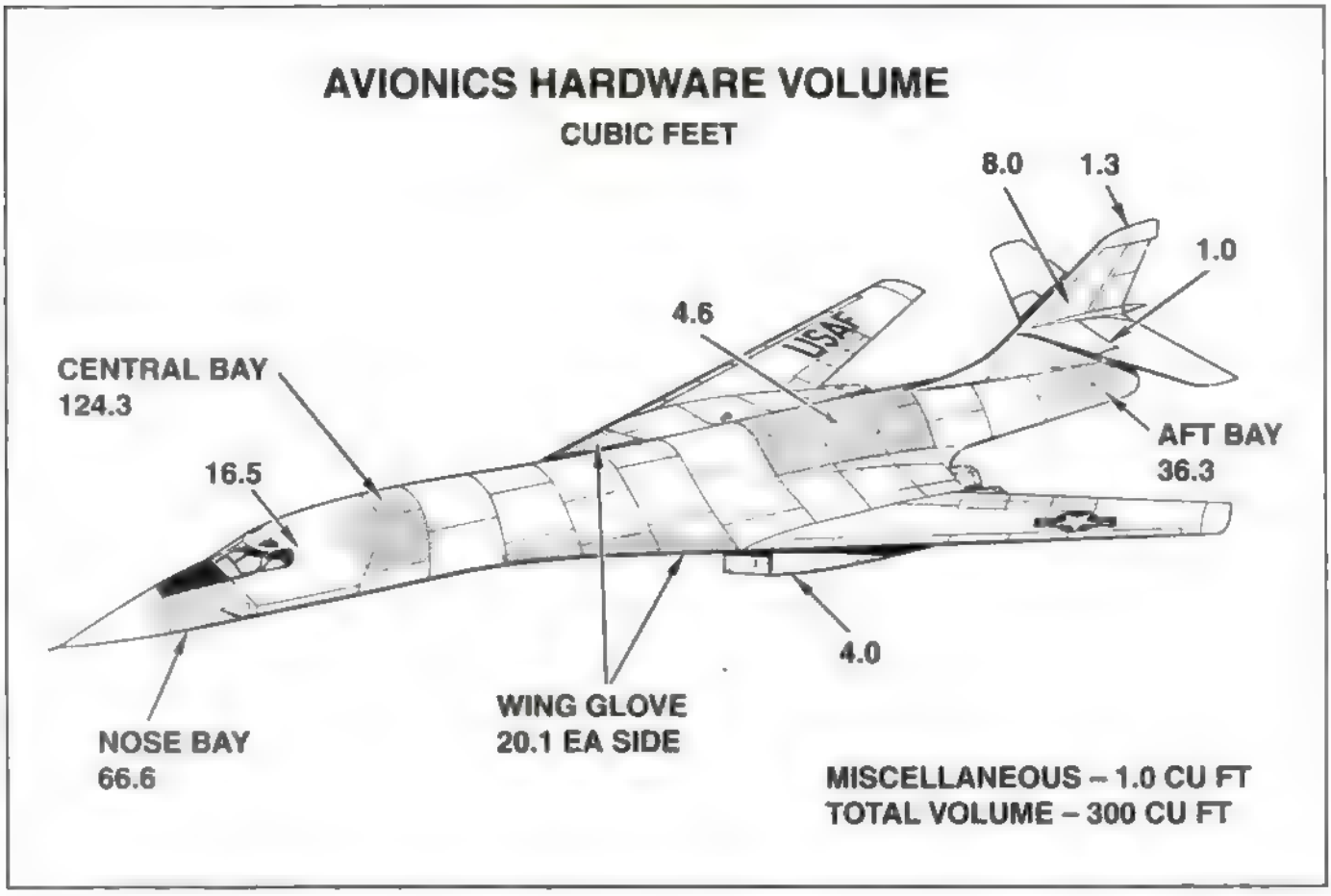
Summary

Although the entire fleet of B-1B Lancer aircraft have been retrofitted to serve as conventional bombardment aircraft, make no mistake, with very little modification, they can quickly return to their original role of nuclear deterrence.

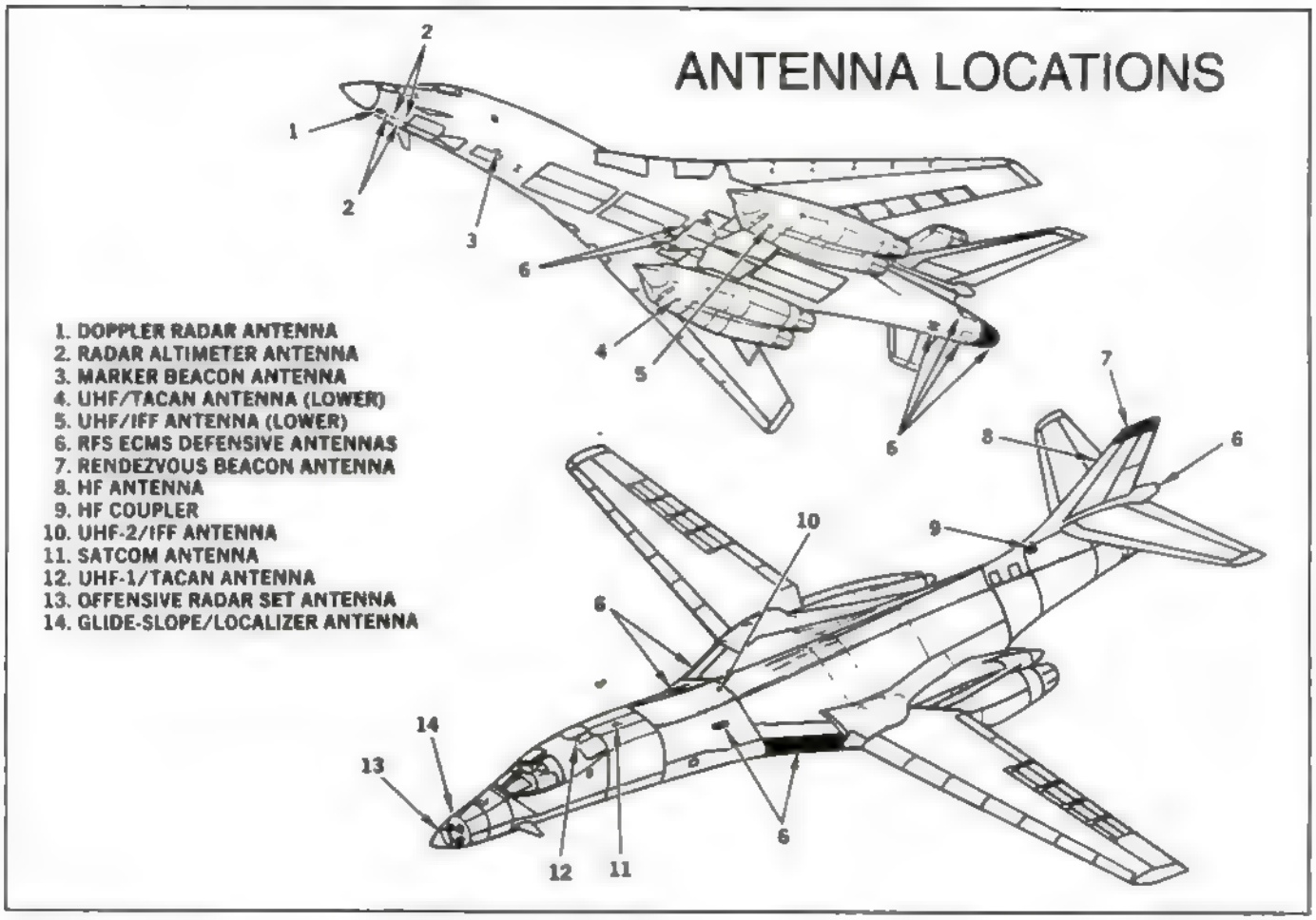
The Air Force's numerous bombardment aircraft, beginning with the Keystone XB-1B Super Cyclops of 1927, steadily evolved for 62 years to culminate with the Northrop Grumman B-2A Spirit of 1989. But five years earlier in 1984, the new kid on the block was the Boeing North American B-1B Lancer. Though not in the same class as the super stealthy B-2A, the B-1B Lancer, stealthy in its own right, is fully prepared to do any job it is ordered to do, whether it be conventional or nuclear.

Four brand new B-1Bs sit on the Palmdale ramp, circa 1987. After extensive systems check-outs and manufacturer's flight testing, they would be delivered to the Air Force. (Boeing North American)

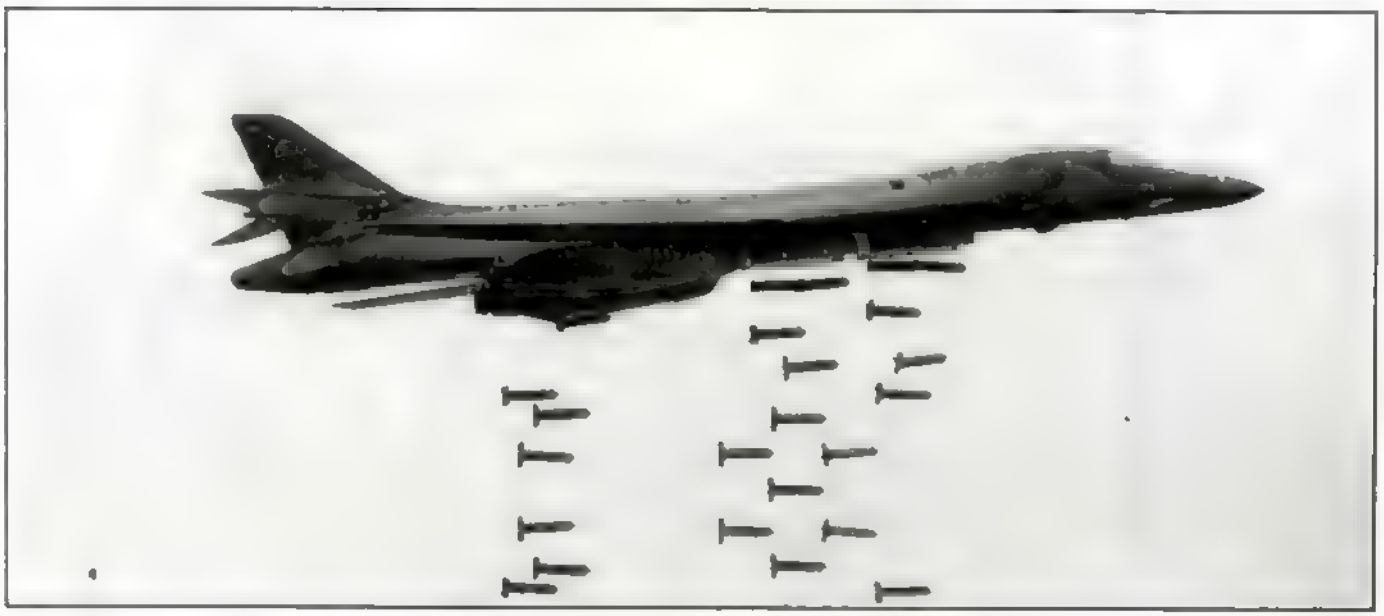
Pilots have raved about the B-1B's excellent in-flight handling characteristics. (Boeing North American)



The Lancer is largely a flying fuel tank with three large weapons bays. Yet, amazingly, it still has adequate room for 300 cubic feet of space for its wide array of avionics. And this does not even count the room it still requires for its four crew members, landing gear and so on. (Boeing North American)



The B-1B has many antennas to support the various avionics systems. Defensive countermeasures systems (RFS/ECMS) antennas are concentrated around the tail fairing and under the fuselage. (Boeing North American)



One of two Edwards AFB-based B-1Bs (85-0068), begins to unload 56 BDU-50 Air Inflatable Retarder (AIR) practice bombs from all three of its weapons bays over the Edwards' bombing range during late 1987. (US Air Force)

Acronyms

Shortcuts to Extraneous Text

ACC
Air Combat Command (established 1 June 1992)

ACM
Advanced Cruise Missile (AGM-129A)

ADM
Air-launched Decoy Missile (ADM-20 Quail)

AFFTC
Air Force Flight Test Center

AGM
Air-to-Ground Missile (AGM-69A SRAM, AGM-131A SRAM II, etc.)

ALCM
Air Launched Cruise Missile (AGM-86B/C, AGM-84A Harpoon, etc.)

AMP
Advanced Manned Penetrator

AMPSS
Advanced Manned Precision Strike System

AMSA
Advanced Manned Strategic Aircraft (B-1A)

ANG
Air National Guard

ATB
Advanced Technology Bomber (Northrop B-2A Spirit)

AWACS
Airborne Warning and Control System (E-3A/B/C/D Sentry)

CMCA
Cruise Missile Carrier Aircraft (747 Jetliner, C-5 Galaxy and so on)

CPB
Chemically Powered Bomber (early version of the proposed WS-110A/L or B-70)

ECM
Electronic Countermeasures

ECCM
Electronic Counter-Countermeasures

EMUX
Electromultiplexing

ERSA(S)
Extended Range Strategic Aircraft (System)

EAFB
Edwards Air Force Base

FBW
Fly by Wire

ICBM
Intercontinental Ballistic Missile

JASSM
Joint Air-to-Surface Standoff Missile (replacement for the canceled AGM-137A)

JDAM
Joint Direct Attack Munition

JSOW
Joint Standoff Weapon (AGM-154A)

LAMP
Low Altitude Manned Penetrator

LARC
Low Altitude Ride Control

LRCA
Long Range Combat Aircraft (B-1B)

MPB
Missile Platform Bomber (B-52G/H)

NPB
Nuclear Powered Bomber (proposed Convair [General Dynamics] WS-125A/L)

RAF
Royal Air Force

RAM
Radar Absorbing Material

RCS
Radar Cross Section

RFP
Request for Proposal

SAC
Strategic Air Command (disestablished 1 June 1992)

SCAD
Subsonic Cruise Armed Decoy (ADM-86A; developed into the AGM-86A ALCM, the precursor of the AGM-86B/C ALCMs)

SCUD
Subsonic Cruise Unarmed Decoy

SLAB
Subsonic Low Altitude Bomber

SLBM
Submarine-Launched Ballistic Missile

SMCS
Structural Mode Control System

SOML
Stand-off Missile Launcher

SRAM
AGM-69A Short Range Attack Missile

SRAM II
AGM-131A Short Range Attack Missile II (canceled)

SWL
Strategic Weapons Launcher

USAF
United States Air Force

V/STOL
Vertical/Short Take-Off and Landing

WS
Weapon System

Significant Dates

Key Dates in the History of the B-1B Lancer

1 May 1960
While flying a spy mission over Russia in a Lockheed U-2, Francis Gary Powers was shot down by a soviet surface-to-air missile or SAM. The result of that action prompted the US to start thinking about just how dangerous the then current high speed, high altitude bombardment mission philosophy was.

11 May 1964
The first of two North American XB-70A Valkyrie aircraft (62-0001), originally created to serve as prototype strategic bombardment aircraft, rolled out of the very same 301/301A building complex the first B-1A would roll out of some 10 years, five months later. Canceled as bombers, the two XB-70As went on to function as high-altitude, high-speed research aircraft attaining maximum performances of 74,000 feet and Mach 3.08.

22 September 1967
Rockwell Standard Corporation and North American Aircraft, Incorporated, merged to form the North American Rockwell Corporation; thus, the North American B-1A became the North American Rockwell B-1A.

3 November 1969
USAF sends its RFPs for the proposed AMSA to Boeing, General Dynamics and North American Rockwell.

5 June 1970
North American Rockwell received a contract to produce two structural test airframes and five flying B-1A prototypes. Simultaneously, General Electric Aircraft Engines received a contract for 40 YF101-GE-100 service test engines.

3 January 1971
North American Rockwell's B-1A prototype procurement contract was amended to produce three instead of five flyable aircraft and one instead of two static test airframes. At the same time, GE's contract was modified to provide 27 instead of 40 YF101s.

18-31 October 1971
The full-scale engineering B-1A mock-up review was held.

15 March 1972
First assemblies on the first B-1A prototype began at Palmdale, California.

26 October 1974
The premier B-1A prototype (74-0158) rolls-out at Palmdale.

23 December 1974
The first B-1A prototype and the first four flight rated service test YF101s operated successfully during the air vehicle's one hour, 18 minutes first flight from Palmdale to Edwards AFB.

25 August 1975
Added to the three-ship procurement in the FY76 defense budget, a fourth B-1A, to serve as the flying testbed for the aircraft's defensive and offensive systems, entered into production at Palmdale.

16 January 1976
Since B-1A-2 was undergoing a series of planned structural tests, B-1A-3 rolled-out at Palmdale before it; it made its first flight on 26 March.

11 May 1976
After serving as the structural test aircraft, and being rebuilt to a certain extent,. B-1A-2 rolled-out; it made its first flight on 14 June.

2 December 1976
North American received a production contract for three operational lot one B-1As, and for long-lead particulars for an additional eight lot two B-1As.

30 June 1977
Prudently ordering a continuation of research, development and flight test activities on the original three B-1As, as well as on the upcoming fourth B-1A ("at a reduced level"), President James E. "Jimmy" Carter, Jr. cancelled the B-1A production program.

5 October 1978
The fastest ever flight of a B-1A (AV/2; 74-0159) occurred over the Pacific Ocean, achieving a speed of Mach 2.22.

30 September 1979
Rockwell International submitted its proposal for a multi-role bomber aircraft using its B-1 Core Aircraft idea.

17 December 1978
The fourth B-1A was completed at Palmdale; it made its first flight on 14 February 1979.

30 April 1981
The fourth B-1A (76-0174) made its last flight to officially end the B-1A test program; it was placed in storage with the other three B-1As.

1 June 1981
The USAF recommended the Long Range Combat Aircraft (the B-1B) instead of General Dynamics' proposed FB-111H as the new multi-role bomber.

2 October 1981
President Reagan announced his decision to proceed with the USAF recommended Rockwell International LRCA program and to build 100 B-1Bs under the Strategic Modernization Program.

23 March 1983
B-1A-2, now serving as the flight test aircraft for the upcoming B-1B program, made its first flight.

30 July1984
B-1A-4, now serving as the defensive and offensive systems test aircraft for the upcoming B-1B program, made its first flight.

29 August 1984
B-1A number two, while serving as the flight test aircraft for the B-1B program, crashed and killed Tommie Douglas "Doug" Benefield, and injured the other two crew members, USAF Maj. Richard Reynolds and Capt. Otto Waniczek.

4 September 1984
Five months ahead of schedule, the first of 100 production B-1Bs rolled-out at Palmdale.

18 October 1984
The first B-1B made a successful three-hour, 20-minute first flight from Palmdale to Edwards Air Force Base.

27 June 1985
The first B-1B to go to SAC, B-1B number two (83-0065), departed Edwards AFB and was flown to SAC headquarters at Offutt AFB, Nebraska, where it was turned over to SAC.

29 June 1985
Exactly 30 years after SAC took delivery of its first Boeing B-52 Stratofortress (an RB-52B) at Castle AFB, California, its 96th Bomb Wing (now 7th BW) at Dyess AFB, Texas, took ceremonious delivery of B-1B number one (82-0001). B-1B number two was to participate in the 96th BW's ceremony but it had been grounded at Offutt due to engine foreign object damage or FOD.

7 July 1985
The first SAC B-1B (83-0065), the second one built, named *Star of Abilene*, arrived at Dyess AFB and was turned over to the 4018th Combat Crew Training Squadron, 96th Bomb Wing (now 7th BW). B-1B number one (named *Star of Palmdale*) returned to Edwards AFB for SRAM/SRAM II missile launch and other weapons tests.

31 October 1985
B-1A number four (76-0174), as B-1B test aircraft number two, makes its last flight in the B-1B defensive and offensive systems test aircraft.

14 April 1987
B-1B number 32 (85-0072) of the 96th BW (now 7th BW) at Dyess AFB flew a North Pole Endurance Mission over 9,411 mi, coming within 160 mi of Russia, in 21 hr and 40 min. Because of its mission, this aircraft was named *Polarized*.

3 June 1987
A 96th BW (now 7th BW) B-1B (85-0072; *Polarized*) successfully completed the first operational aircraft launch of a AGM-69A SRAM.

24 November 1987
B-1B number nine (85-0049), named *Thunder From The Sky*, successfully completed the first test launch of an AGM-86B ALCM; it directly impacted its targeted area on the Utah Test Range.

20 January 1988
Under budget and ahead of schedule, the 100th and last B-1B (84-0140) rolled out at Palmdale.

2 May 1988
B-1B number 100 was delivered to the 384th BW (later 394th BW) at McConnell AFB, Wichita, Kansas.

25 March1989
Four B-1Bs of the 96th BW (later 7th BW) deployed to Elmendorf AFB, Anchorage, Alaska, for Giant Warrior 99-3 which marked the first Lancer deployment outside the contiguous United States.

15 March 1990
After numerous considerations—the unofficial name Centurion being the near winner, the official name Lancer was adopted for the fleet of B-1B aircraft.

17 July 1991
Following the successful release of 84 live 500-pound Mk 82 conventional free-fall air inflatable retarder or AIR bombs on a Utah Test Range target, the non-nuclear weapon certification of the B-1B was completed; B-1B number 59 (86-0099; *Ghost Rider*) was the delivery aircraft.

28-29 February and 18 March 1992
Two unmodified 319th BW B-1Bs (86-0111 and 86-0121) set 12 world time-to-climb records flying out of Grand Forks AFB, North Dakota. The 319th BW was later redesignated the 319th Bomb Group, then inactivated in June, 1994.

4 September 1994
The B-1B and those involved with its creation, production and use celebrated the 10th anniversary of roll-out of B-1B number one (82-0001).

18 October 1994
The B-1B Lancer celebrated the 10th anniversary of its first flight.

6 December 1996
The Boeing Airplane Company purchased the North American Aircraft Operations Division of Rockwell International Corporation; thus, the Rockwell B-1B Lancer became the Boeing North American B-1B Lancer.

26 May to 3 July 1997
A record number of ten B-1B Lancers deployed to Great Britain and proved their capabilities in three NATO exercises. This was the first time that two B-1B Bomb Wings—the 7th BW, Dyess AFB, and the 28th BW, Ellsworth AFB — became one at a forward operating location. RAF Fairford became home to the two units known jointly as the 7th Expeditionary Bomb Group.

14 November 1997
Two Air Combat Command B-1Bs of the 8th Air Force, 28th BW, 37th BS, departed Ellsworth AFB, South Dakota, for deployment to the Persian Gulf region; one rotated back for depot maintenance on 5 February 1998.

7 February 1998
Secretary of Defense William S. "Bill" Cohen signed an order to send more aircraft, including two additional B-1Bs, to Bahrain in the Persian Gulf region for possible action in Operation Desert Thunder; this made a total of three B-1Bs in the area.

15 February 1998
Two additional B-1Bs of the 28th BW, 37th BS, departed Ellsworth AFB, for possible participation in Operation Desert Thunder. They joined a 28th BW B-1B that had been in Bahrain since 15 November 1997.

18 February 1998
While on a training mission out of Dyess AFB near Abilene, Texas, a B-1B (84-0057; *The Hellion*) of the 7th BW, 9th BS, crashed near Mattoon, a rural area some five miles northeast of Marion, Kentucky. Its four crew members ejected safely to survive the mishap; the aircraft continued on and flew some 12 miles before it crashed to destruction. Other than the cockpit filling up with smoke, no immediate cause of the crash was announced at the time of this writing; it was the fifth total loss of a B-1B Lancer.

By January 1971, however, the B-1A contract had already been modified—instead of five B-1A prototypes, there would only be three. There was still a lot of enthusiasm within the B-1A program, but this marked the beginning of the end for the B-1A as a production bomber.

Then, in early 1981, Ronald Reagan replaced Jimmy Carter in the White House and the largest peace-time military build-up in US history began. Only the B-52G/H and FB-111A remained in operational service with SAC. But suddenly, the Air Force found itself getting not one but two new bombers. They were the B-1B Lancer, a modernized version of the canceled B-1A, and the Northrop B-2A Spirit stealth bomber.

The B-1B was the result of a significant re-engineering effort to improve its survivability. Although the B-1B is not considered a stealth aircraft, careful tweaking has resulted in an aircraft that is about 100 times less visible to radar than the B-52H. And it is markedly less noticeable than its B-1A predecessor which had a radar cross-section (RCS) of 2.81 square meters.

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